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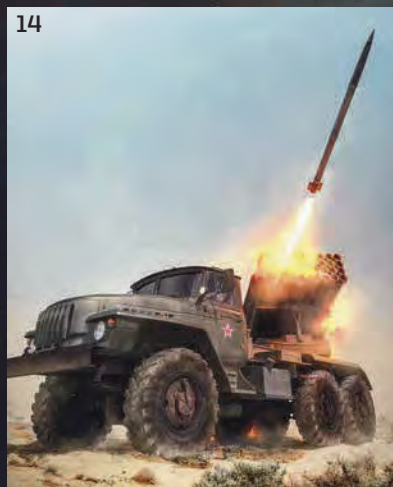
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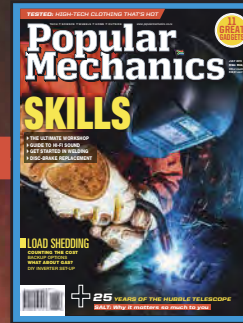
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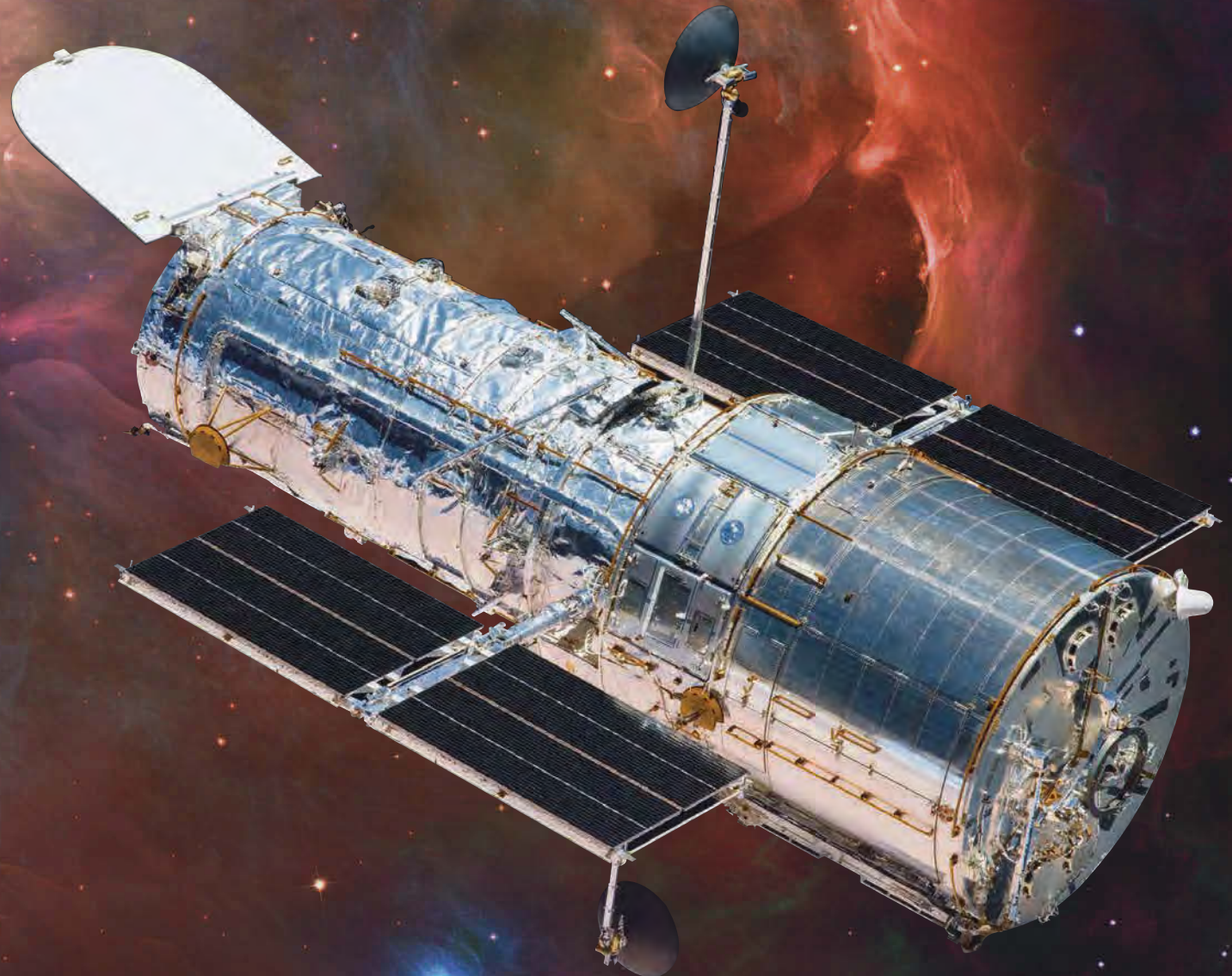


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CAN-DO CULTURE

IT'S A PRIVILEGE TO BE ABLE TO VISIT FARAWAY PLACES

and experience other cultures and sights, as we often have to do in our line of work. Case in point: I have just returned from South Korea as a guest of LG on its 2015 Home Appliance and Air Solutions press tour. Having been to the country before, I couldn't resist, on occasion, stepping back to note the reactions of my fellow travellers, all of whom were first-timers. It's safe to say that they were bowled over by this Asian Tiger's bustle and restless innovation. Yet at the same time there's a conscious effort not to let go of traditions and history.

So, in the space of one day the visitors were given insights into how we'll be managing tomorrow's households (by remote control and apps, of course) and given a feel for the country's heritage in the form of Hanbok, which is Korean traditional dress. Our tour group was guided through the art of dressing up in the finery and rich colours of a bygone era – and a fine-looking crowd we made, too. Even if I say so myself.

When we weren't soaking up local culture – and that includes soju, kimchi and that international treasure of Korean performance art, Nanta – we were trying to give our hosts an understanding of some of our own local traditions. Actually, one tradition in particular.

It was wry smiles and nodding heads all round at most of our business sessions as the inevitable question, sadly, came up: "These ideas are great. But what about load shedding?"

Fortunately, they're on top of that, as well as they can be. Besides the obvious drive towards greater efficiency in operation, other ways of mitigating the effects of power outages include auto-restart systems and battery operation. We'll be looking at the implications in an upcoming issue.

For the moment, though, we will continue to keep South Africa's energy crisis in sharp focus. This month in Beat the Blackout we examine alternatives and solutions – effectively, what we as consumers can do. In future issues we'll look at the broader view. It seems appropriate to use load shedding as the basis for our latest Workshop Challenge. Let's get creative. After all, we're a can-do culture, too.

Anthony

anthony@ramsaymedia.co.za

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BEAT THE BLACKOUT

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Go Further



INSPIRATION STRIKES

I just wanted to thank you for the inspiration provided by your "Tool Restoration Project" article in the April issue. The segment focusing on corroded hand tools got me up into the rafters of my father-in-law's garage, from where I secretly took his old air rifle that had been decaying up there for the past 30-odd years. Despite the condition in which it ended up, he's clearly sentimental about it. He often talks fondly of how he bought it at an auction with his own pocket money at the age of just 10. (And once killing a little mossie with it and crying for days/never shooting at another living thing again.)

By following most of the advice in the article I managed to restore it (below) to – nearly – its former glory. Well, at least in terms of looks: it'll never fire again. In the process of working on it, I discovered that part of the cocking and trigger mechanisms were broken off and long lost. But I reckon he'll be pretty chuffed to have it hanging over the braai in his man cave after I give it to him for his birthday!

DARREN NESBITT
BREDASDORP



Write to us, engage us in debate and you could win a cool prize. This month's best letter will receive an HTSE watch developed by TITAN and valued at R3 795. HTSE, or High Tech Self Energized, is a collection of futuristic, light-powered watches capable of being charged by any light upwards of 200 Lux. HTSE timepieces draw design inspiration from some of the most complex self-energising bodies built: space ships, orbiting space stations and satellites. Their impressive array of features includes End of Life battery charge indicator, Sleep Mode to increase battery shelf life and Over Charge Prevention to protect the battery. HTSE – for those driven by technology. For stockist enquiries, please contact Luxco on 011 448 2210 or visit www.luxco.co.za

Send your letter to: POPULAR MECHANICS, PO Box 180, Howard Place 7450, or e-mail popularmechanics@ramsaymedia.co.za Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

REVIVING A BATTERY - CORRECTLY

The method of jumpstarting a car with a dead battery, detailed in your August issue is – sadly – wrong. Especially for modern cars.

The first mistake depends on exactly how "dead". If the stricken vehicle's battery were stone dead, switching off the supply car would be a mistake.

Secondly, on modern electronic cars you must switch on the park lights to absorb the surge when connecting and when starting the other vehicle. Preferably on both.

Thirdly, when the other vehicle starts running, it won't actually charge the old battery because the "new" fangled (actually, nearly a century old by now) alternating current, which is then half-wave rectified, is just not suitable for more than topping up the charge on a fully charged battery. In the old days when generators were installed, then yes. Driving around for two hours would have charged the battery. But never on an alternator-equipped vehicle, as the alternator has too much to deal with, just to keep the modern car running, never mind charging a dead battery. No, as soon as

WINNING
LETTER

you get it started go to a battery specialist's or buy a battery trickle charger and a hydrometer.

The way to do it is to disconnect the dead battery from the car's electronics and take off the earth cable. Preferably both cables, just in case you've got a weird wiring set-up.

Then remove the battery caps, if the battery has them, and check the water level. If it is low and you are nowhere near a ready source of suitable distilled water, it's acceptable to use boiled tap water to top up the cells until the bottom of the cell cap threads.

Charge the battery and, once it's charged, DO NOT PROVIDE ANY SOURCE OF SPARK: this is very dangerous. Take the hydrometer and draw up some of the now acidic water. The float should be in the green. Test all the cells and, if one or two are not accepting charge, drive to your nearest supplier and replace the battery.

Incidentally, always try to have a rubber battery mat under the battery, to keep the battery from being affected by cold metal.

Lastly, when connecting the negative, any good earth connection will do. Often, when parked at a funny angle, in modern cars you cannot get to or even find the earth. Instead, locate a bolt or bit of engine that is clearly metal and put the clamp on there. Yes, you can use the body, but sometimes a poor earth caused the problem in the first place. By doing it this way, you reduce the chance of that affecting the current draw somewhat.

I hope this helps more people to not short out their engine management computers, which the other method has been known to do, costing my clients thousands in CPU and on-board computing replacements in BMWs, Mercedes and the like.

HILARY ALBUTT
FALCON MANAGEMENT SERVICES

(South Africa's first female motor mechanic – as far as I know – to run her own small chain of garages.)

MAKE WISE TECH CHOICES

Reading the letters of late about all the tech we can and do need to use to get ourselves sorted during this Eskom- and government-induced dark age we are navigating at present, I think there is something we earnestly need to take a long and hard look at: it simply takes an inordinately vast amount of resources and tech to sort out amateurish and ill-informed politicians in power. There are things that could be better served by this vast investment in thought, time and energy currently being invested into getting around (not fixing, mind you – that is something individuals can for the most part only dream of) one single mistake the govern-

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ment made in 1997/8 when they denied Eskom the licence to build additional powerplants.

One single mistake. One.

Can it be that we, as tech-savvy people, need to realise that present-day decisions may cause generations of misery in the future? Beware of what tech (drones included) we develop today to steal our liberties in future.

Let's take cognisance of the fact that bad choices in our society – technical or not – may keep us sidetracked from some very worthwhile pursuits in areas such as medicine and food production for a very, very long time.

COBUS VAN DER MERWE
BY EMAIL

VR ON THE CHEAP

In your article about Virtual Reality headsets (How Your World Works, June 2015), I was surprised to see that the Google Cardboard was not included. I ordered one recently

from Groupon; it took about a week to arrive. The flat-pack DIY assembly is actually quite a nice touch for such a cheap device (R170). I used my Galaxy Note 4, which didn't really fit, so I made a plan by modifying it a bit. Lo and behold, I had a very low-cost headset with a very high-resolution display.

The experience was truly breathtaking. From almost falling off my chair whirring around on a roller coaster, to standing on the stage while Sir Paul McCartney played piano, or being in the middle of WWII. I had everyone in the office take a look – even the tea lady, who didn't really understand what was going on.

Seeing everyone's reactions made me realise how far we have come. Tech is so cheap an ordinary Joe like me can afford it. And then, I started thinking, where to next? What is the next big, mind-blowing piece of tech that we'll see, and that won't cost an arm and a leg?

I, for one, am excited.

CHRIS GROBLER
PRETORIA



WELL DONE - BUT BE CAREFUL

I have a warning for those that want to go the same route as Robin Leham of Northcliff (Do it Your Way, May 2015). His suggestion of connecting an inverter to his car battery is a good, practical and economical solution. But bear in mind that, for every ampere AC drawn from the 240 V side, the input current from the 12 V battery to the inverter will be 20 A DC (assuming that the inverter is close to 100 per cent effective).

Apart from calculating the value, I have recorded the parameters of a 500 W inverter, shown in the accompanying photo (wattage of the inverter is immaterial). The AC load was 200 mA, which resulted in 4,2 A being drawn from the battery. The extra 200 mA on the DC side was drawn by the internal cooling fan of the inverter itself. Over long periods, this will affect how long the battery lasts.

The 600 W inverter Robin used will

be capable of delivering 2 A AC at an enormous 40 A DC from the battery.

Taking the load Robin mentioned in his hint as a conservative 800 mA, it would result in 16 A from the battery via the cigarette lighter wiring. If other potential users follow this route, they might just use more than Robin did. This could be dangerous for the cigarette lighter wiring.

I do not think that the normal cigarette lighter wiring of any car can handle this safely. To optimise the car battery for the inverter, use higher-current clamps from the battery (not from the cigarette lighter outlet) and then use an extension to a multiplug as I did during my experiment. This arrangement keeps the thick wires from the battery short and safe.

Robin also proved that expensive deep cycle batteries are not necessary for such applications with inverters. I find that the inverter will never drain the battery completely, because it switches itself off when the battery voltage goes below 11,4 volt. So, even with the deep cycle batteries – which are capable of being discharged to lower voltages without damage to the battery – you will not benefit from this particular advantage.

Well done, Robin and happy viewing to all who are going this route.

LOURENS ODENDAAL
CENTURION

COME ON, GUYS - GET ORGANISED

The article on "How to load a dishwasher" (May 2015) forgets the more important aspect of *unloading* the dishwasher. Here, strategic planning can save you days over the lifetime of a dishwasher.

Take, for example the sorting of the randomly packed knives, forks and spoons into the cutlery tray, not to mention trying to pack away a cereal bowl between dinner plates. Therefore, this is what I do when I live alone: table knives in the first right-hand basket compartment, forks in the next, then spoons, followed by teaspoons in the last one. Sharp prep knives, because they are often a bit longer, in the left slot closest to the door, otherwise they can interfere with the rotating nozzles (and they must point down for safety reasons).

Then, when I unpack, it's a dream – one handful at a time goes together into the correct cutlery tray. Similarly, all identical dishes are stacked together so that you can grab them with one hand and they glide into the cupboard effortlessly. Saves a few minutes every day!

The problem comes when I am living with my wife, as she believes knives and forks go together... and if we are to separate them, spoons should go in the back right slot...

There must be a gap in the market for a "his and hers" dishwasher combo.

HUGH MCGIBBON
BY EMAIL

THE POWER LIES IN OUR HANDS

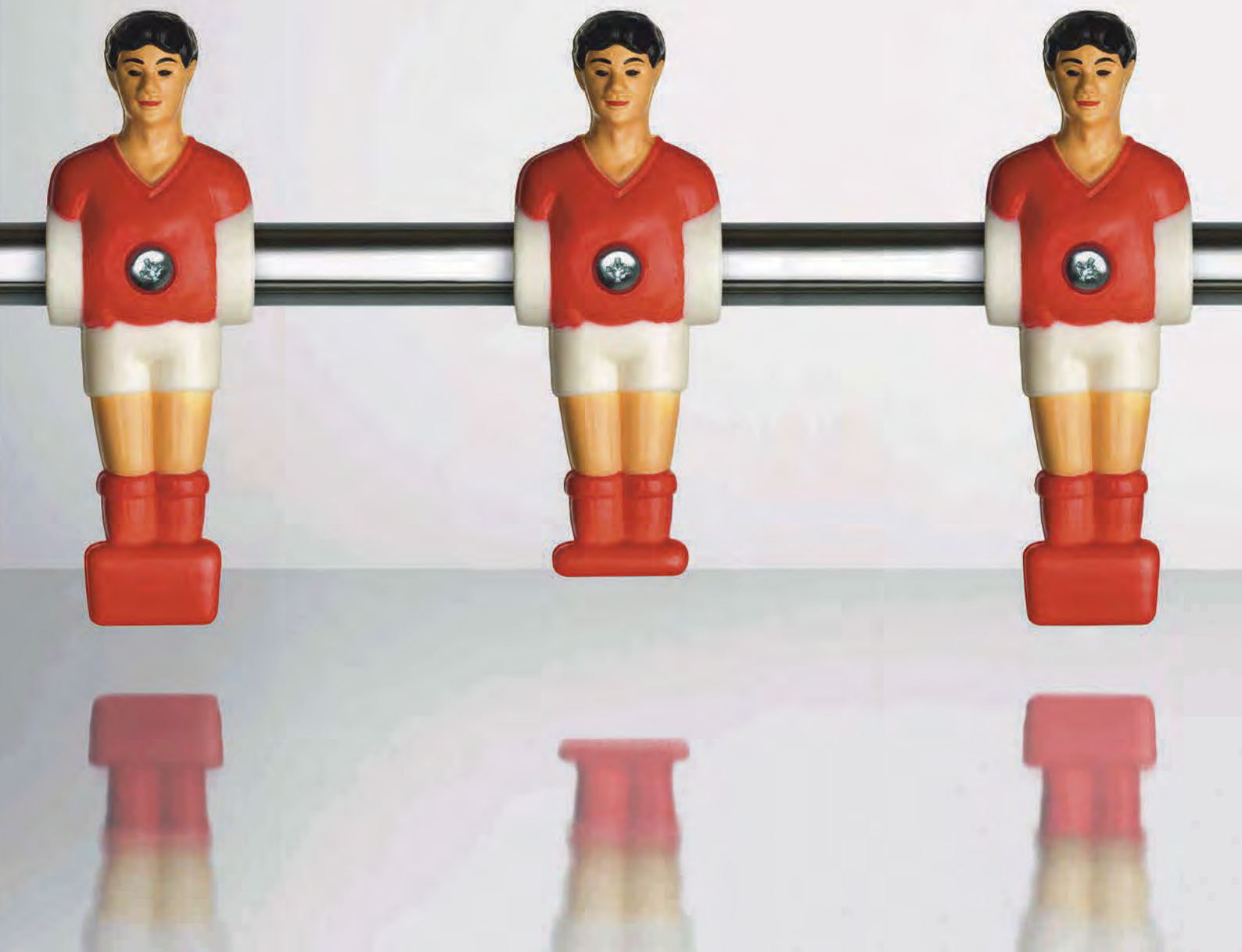
I need to congratulate the author of the winning letter of your May issue; every kWh saved adds up.

The most cost-effective way to beat the load shedding blues is more common-sense use of appliances that consume electricity. "Vampire loads" (equipment that drains electricity, while not in use, when still plugged in), is a simple start. It costs nothing to switch off laptops, printers, TVs and radios at the wall. In an average household, this might add up to 100-200 Wh. With a million households, 100-200 MWh can be saved. I have no empirical data to base my argument on, but larger homes in more affluent areas surely consume even more electricity. Savings from reduced "vampire loads" could be as much as 1-2 GW/h.

Many more common-sense actions can nip load shedding in the bud. For instance, pay attention to energy efficiency when buying new appliances.

Please stop cursing when the lights go out. Rather think, act and let's take personal responsibility for finding solutions.

ADRIAAN DE LANGE
CRADOCK PM



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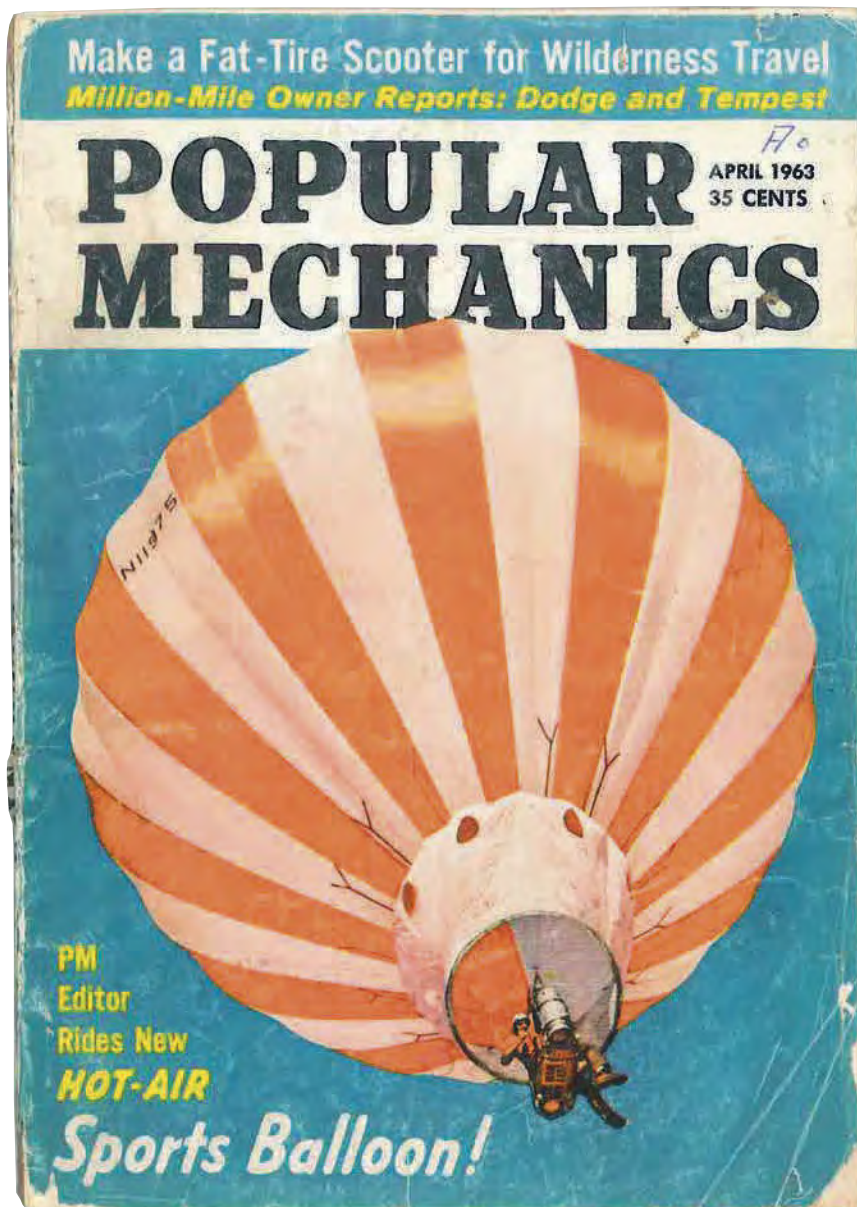




1963 Perhaps now they'll believe you that those voices were real, after all. These "guns" mounted on the door of a US Air Force transport aircraft were actually loudspeakers used to broadcast messages to enemy troops. Part of psychological warfare, the messages were sent over planes' air-to-ground public address systems in low-level missions.



1968 PM's prediction success rate improved markedly between '63 and '68: in our pick of the new inventions, we predicted man-made waves ("surfing in a swimming pool miles from any ocean") and interchangeable truck bodies, both of which made it into reality. Not so successful were a helmet-mounted shower for firemen, hanging cabins for ocean travellers and multipurpose pillows.



1963 It didn't turn out quite as envisaged after our intrepid roving editor soared aloft in a new hot-air sports balloon. Although PM predicted that the unfortunately named Vulcoon might soon fill the weekend skies with amateur balloonists, the new leisure-time pursuit failed to... er... take off. As for PM editors, after a painful but mercifully brief encounter with a mountain bike, the incumbent is understandably reluctant to commit to similar high-flying activities.



1958 What do you get when you marry a Ford Anglia chassis, a cut-down Chevrolet bonnet, the rear window from an American Ford and the wheels from an Austin Bantam? Clearly something not quite distinctive enough: the US Air Force officer who created this vehicle in Wetherfield, England, then added the finishing touch of two wing tanks from a T-33 jet trainer. We should be grateful that his interests didn't extend to farming implements. **PM**

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HOW TO WIN AN ARTILLERY WAR IN 2015

Russia's proxy army is inflicting heavy damage with rocket launchers in the new cold war. American drones, lasers and other pioneering weaponry are helping Ukrainians fight back.

BY JOE PAPPALARDO

New technology has turned the old Russian BM-21 Grad, shown here in an artist's rendering, into a far more lethal piece of equipment.



THE UKRAINIAN ARMY'S 24th Mechanised Brigade had just passed through the village of Zelenopillya at 4 AM last July when the sky detonated. Dozens of 122 mm rockets fell on the convoy in an area claimed by Russian-backed separatists, each rocket carrying about 20 kg of explosives in warheads built to fragment into shrapnel. Within moments 19 soldiers lay dead and scores more wounded.

Vehicles were shredded. The rebels likely used a BM-21 Grad, a six-wheeled vehicle with 40 launch tubes that can all fire within seconds (grad means hail in Russian).



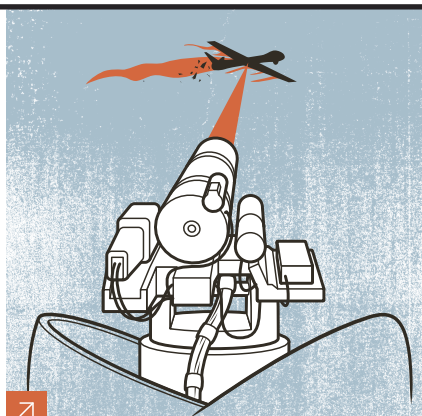
THIS MONTH IN
Putin

The Guardian revealed that Russia hires bloggers to, among other things, criticise Ukraine, praise Putin and promote Russia's top-selling YotaPhone.

These attacks haunt Ukrainian troops: a Brookings Institution field report said the bombardments account for 70 per cent of their casualties. In fact, multiple-launch rocket systems (MLRS) are now so common that more than 80 nations, including Syria and Iran, deploy them. So do terrorist and other non-state Middle Eastern groups. MLRS operators

can park and launch within two minutes, then quickly relocate to a bunker, under a camouflage net, or inside a cave – the tactic is called shoot and scoot.

And they don't fire blind. In Ukraine, Russian drones with video cameras provide separatists with valuable information. Ukrainian soldiers have told reporters that they often see the drones overhead before an MLRS bombardment but have no way to shoot them down. The Brookings researchers reported that the Russians deploy UAVs (unmanned aerial vehicles) and artillery in tandem "with devastating effect." In response, the US military is ramping up its own technology to help its ally fight back. Here are four prime examples:



AIR-DEFENCE LASERS

In 2014, the US Navy's first laser weapon – a warship turret that can crisp small boats and UAVs – became operational. The 100 kW system, now deployed in the Persian Gulf, burned a hole through a drone in seconds during target practice. Next the Navy wants more compact, stable and rugged weapons that can shoot drones from Humvees. The Office of Naval Research announced an industrial contest to create laser weapons that can do the same with just 25 kW. Demonstrations are expected in 2016.



PORTABLE AIR-DEFENCE RADAR

Once it's possible to hit the UAVs with lasers, the military will be able to locate them using mobile warning radar. Active electronically scanned arrays (AESA), which can easily be carried in vehicles and set up on tripods, send out pencil-thin radar beams with jolts of current that scan the sky for drones. Some US versions can detect, classify and track any kind of airborne object at altitudes ranging from 10 m to around 10 km and have ranges of up to 30 km.



MLRS-TARGETING TECHNOLOGY

The modern battlefield is blanketed with sensors – mobile ground radar, acoustic surveillance equipment at observation posts, satellite imagery, and infrared camera feeds from drones – that can be used to help find MLRS locations. Last year the US Marine Corps began developing software to identify an incoming threat using all data, then plot the exact location for return fire – which could "compress the kill chain timeline", says one military document.



MEDIUM-RANGE UAVS

Drones that can travel beyond an operator's line of sight are ideal tools to pinpoint mobile artillery. The MQ-5B Hunter can fly at five kilometres, high enough to avoid most ground fire. It is capable of both scanning the terrain below with an array of cameras (including infrared) and intercepting signals from enemy communications. The MQ-5B can stay in the air for 21 hours, beaming back real-time information for counterattacks.

A SEARCH ENGINE TO STOP ISIS

There's a scary Internet that most of us have never seen. It's called the Darknet – a free-for-all marketplace of drugs, sex, guns and everything else your parents warned you about. Darknet sites won't show up on Google, but they will show up on Memex, a new search engine designed by Darpa that reaches every corner of the Web. Originally created to combat human trafficking, Memex is now used to fight the Islamic State group. Many ISIS supporters use Darknet to funnel money, often Bitcoin, to terrorist cells. Memex searches, indexes and cross-references forums, advertisements and chats, identifying patterns that point law enforcement to the payment sources – where ideally they can be stopped. – CAMERON JOHNSON

how do i
how do i get a girlfriend
how do i fix my DVR
how do i take a screen shot
how do i renew a passport
how do i make dinner
how do i train my dog
how do i catch a terrorist

HOW YOUR
WORLD **WORKS**

THE ASTRONAUT SWEATER

This new sweater uses NASA technology to adapt to your body temperature. And it's stylish, too.

BY SARAH Z WEXLER

SEASON CHANGE IS TRICKY. IT'S COLD, THEN IT'S hot, then it's cold again. It's annoying. And it means you need a sweater. But what would really be great is a sweater that uses the same technology that's been protecting astronauts for twenty-five years.

Gihan Amarasiriwardena, who trained as an engineer at Massachusetts Institute of Technology, partnered with two students at the business school to launch an online clothing company, Ministry of Supply, in 2012. (The first permanent physical store opened in 2014 in Boston.) Their goal was to combine the technology of athletic gear with the style of dress clothes. At first this meant using moisture-wicking, stretchable fabric to make button-downs, but then the company incorporated phase-change materials, which were used in textiles by NASA to regulate the temperature inside a spacesuit. (If an astronaut faces the sun with his back to deep space, the temperature difference on the opposing sides of his spacesuit can be as high as 275 degrees.) This year Ministry of Supply unveiled its first thermoregulatory sweater, the Mercury.

Here's how the technology works in regular gravity: the sweater is made of moisture-wicking merino wool blended with acrylic. Each fibre is embedded with a tiny amount of paraffin wax, which



freezes or melts in response to its surroundings. As you overheat, the wax melts, turning from a solid into a liquid, kind of like a candle, and drawing out excess body heat to cool you off. When you get cold, the reverse happens. The wax freezes into a solid, causing it to release the stored heat back to you. The full process – in either direction – takes about seven minutes and is much easier than opening a window. And it does all this while still managing to feel as comfortable as a typical sweater.

Amarasiriwardena also paid extra attention to the body's hot spots. Using infrared thermography, he mapped the key areas that expel heat (no surprise: your armpits) and cooled them by adding six ventilation holes to reduce fabric density by 25 per cent. Instead of sewing in these panels separately, Amarasiriwardena has them made with 3D robotic knitting, like 3D printing for clothing. The machine prints out the sweater in panels and tubes that it links together as it works. The sweater comes out of the machine as one seamless garment, thereby avoiding any additional itchiness or annoyance. Scott Kelly wouldn't tolerate either of those things. And neither should you.

The new
Fjällräven Duffel
No. 6. (The j is
silent. So are the
umlauts.)



ADD YOUR OWN WAX

A good duffel needs to be tough. Fjällräven, the Swedish outdoor company, just introduced a new bag – its first to fully convert into a backpack, with straps that hide inside the bag until you need them. The Duffel No. 6 (starting at R3 000 for a 50-litre bag, which is plenty of space to get you through a weekend) is already durable and water-resistant, since it's made out of a cotton-polyester blend impregnated with paraffin and beeswax. But the bag can be even tougher, as long as you're willing to put in a little work. For an extra R150 you can pick up your own bar of Fjällräven's homemade Greenland wax. Rub on as much as you want, iron it in, and your duffel becomes practically indestructible. If you change your mind, you can remove the extra wax by running the bag through the laundry. But why would you?

IN DEFENCE OF FROZEN FOOD

When it comes to fruits and vegetables, the freezer just might be the most underrated tool in your kitchen.

BY WYLIE DUFRESNE

PHOTOGRAPH BY STEPHANIE DIANI

WITH THANKS TO SYED RIZVI, PROFESSOR OF FOOD PROCESS ENGINEERING AT CORNELL UNIVERSITY.

IN ONE OF MY RESTAURANTS, a cook once came up to me and announced in disgust that he couldn't possibly work in a kitchen that used frozen peas. It didn't bother me that he had challenged my authority. It did bother me that he was dead wrong about frozen peas. Many people think of frozen food as a cheap shortcut, a last resort. All of them need to get off their high horse and make a batch of pea soup, immediately.

Almost every good cook's epiphany about frozen food comes while making pea soup. First, frozen peas eliminate the gruelling task of shucking. Second, a soup made of frozen peas will be substantially sweeter and better tasting than a soup made of fresh peas. Fergus Henderson, the chef of St John in London, said it best: "Wait until peas are in season. Then use frozen."

Is there a downside to freezing? Sure. That's where the reputation comes from. When a food gets extremely cold, what is really freezing is the water within it, which expands and forms crystals that can tear at the food's structure. Done improperly or to the wrong food, this can destroy both taste and texture:

Our columnist takes a break from eating all the bananas in his restaurant's freezer.

HOW DIPPIN' DOTS ARE MADE

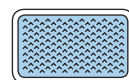
- **Step 1:** At the production facility in Paducah, Kentucky, dairy mix and flavouring travel through 2.4 km of piping to one of five cryogenic processors.
- **Step 2:** In the processors the mix rains into a -195° pool, flash-freezing into 4-millimetre spheres.

Relative ice-crystal size in slow versus fast freezing



REGULAR FREEZING

Water droplets cluster while crystallising, breaking cell walls.



FLASH FREEZING

Smaller, more numerous crystals form before water can move.

You can't, for example, freeze corn on its cob – you'd have to cook it that way, then present your texturally weird, freezer-burned corncobs to your dinner guests.

There are, however, foods that are improved by the freezing process. Peas are one of them. (Another, surprisingly, is octopus.) In fact, many frozen fruits and vegetables taste as good as or better than their fresh counterparts. All fruits and vegetables start to degrade the minute they leave the field: Enzymes convert the sugars into starches and the light, heat and handling

that go into moving a crop from field to market inevitably damage it. Because frozen foods are picked at the peak of ripeness, then blanched and frozen, they stay as tasty as they'd be if you had eaten them in the farmhouse next to the field where they grew. This is why Birds Eye famously promises two and a half hours from field to freezer. And according to studies done at the University of California, Davis and the University of Georgia, because freezing stops fruits and vegetables from breaking down, frozen foods are often higher in nutrients than fresh ones.

Even at ages 2 and 5, my kids see the value in the extremely sweet fruit that comes from the freezer. The younger one eats frozen blueberries by the bowlful (I prefer these to fresh ones flown in from another country) and both of them are amazed by the creamy texture and profound sweetness of frozen bananas. When I dice up some of the latter and stir them into an otherwise boring bowl of oatmeal, I'm magically a good dad: I'm getting fibre and vitamins into my daughter, and, for once, she thinks I'm a decent cook.



FLASH-FREEZE YOUR SUMMER PRODUCE

If you have R10 000 to spare for a really fun toy, you can buy a PolyScience Anti-Griddle, which has a minus 30 degree surface that will flash-freeze almost anything. If you don't, chop your produce into small pieces. Blanch vegetables for several minutes in boiling water, then dry. Fruit is fine as is. Spread produce on a baking sheet in a coolerbox full of food-grade dry ice. Once the produce is frozen, you can bag it up and transfer to the freezer.

**THE VISIBLE
LIGHT SPECTRUM**

The colours you see, sorted by wavelength.

450-470 nanometres

Harsh, short-wave-length light from phones and tablets

600 nanometres and up
Candlelight and dark-room light: minimal effect on sleep patterns

540-560 nanometres

Peak intensity for a typical fluorescent bulb

BEWARE THE LIGHT

Most people stare at screens at least eight hours a day. This is not a good thing. BY ALEXANDER GEORGE

MY OBSESSION WITH EYESTRAIN started in junior high. Within a year of getting my first laptop, I had to be fitted for my first pair of glasses. From then on I did everything I could to keep my eyes from getting worse. Originally that meant turning my monitor brightness way down and taking frequent breaks from the screen. But in the years since, as research pours in showing that our constant exposure to artificial light may lead to everything from insomnia to obesity to prostate cancer, I've had to up my vigilance. Which meant incorporating some potentially embarrassing equipment to protect myself. Forget vanity. I needed a solution – one that didn't involve spending any time away from my phone.

F.lux, free

Type in your time zone and as the sun sets, f.lux slowly turns the harsh blues and whites on your screen to candle-like yellows and browns. Your brain confuses blue light for daylight, affecting your circadian rhythm and suppressing your body's natural sleep agent, melatonin. Richard Stevens, a professor of community medicine and health care at the University of Connecticut, says that "after dusk, you want light that's as dim and red as is comfortable".

Gunnar Haus glasses

The tinted lenses reduce high-energy blue light that, according to Ron Adelman of the department of ophthalmology and visual science at Yale University, tires out your eyes. And the glasses' anti-reflective coating helps with glare from overhead lighting, which, Adelman says, "reduces your eyes' sensitivity, forcing them to work harder to see details".

Philips Hue Go

To combat morning grogginess, I set the colour-adjustable Hue lightbulb to fill my bedroom with blue-rich white light. Carrying it around during my morning routine has replaced the industrial-sized coffee I used to need. At night, I set Hue Go to a deep red. Aircraft carriers often use red lights in sleeping quarters to illuminate a space without jolting your brain awake.

Moleskine Evernote Weekly Planner

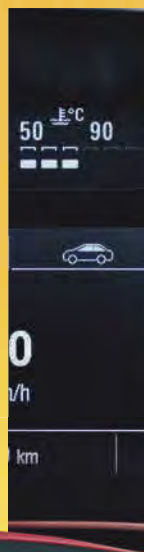
Besides giving your eyes a break from glowing screens, writing by hand results in greater comprehension. With Moleskine's Evernote technology, you write a note, then take a picture of the page with your phone. The app uses the page's dots to decipher the ink, turning your handwriting into searchable text. I've had to learn to write more legibly, but I needed to do that anyway.

Orange

Lots of vitamin C. Good for the eyes.

Q3/Q4 expenses

Eye doctor appt.



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THE NEW OH! HAS ARRIVED

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*On the Road and Registration Fees excluded. Terms and Conditions apply. Errors & Omissions excepted. Model/s shown may differ.





Do you have unusual questions about the world and how it works and why stuff happens? This is the place to ask them. Don't be afraid. Nobody will laugh at you here. Email popularmechanics@ramsaymedia.co.za Questions will be selected based on quality or at our whim.



WHY DO SCI-FI WRITERS ALWAYS SEEM TO OVERESTIMATE HOW MUCH THE WORLD WILL HAVE CHANGED BY THE YEAR THEY'RE WRITING ABOUT?

A IT'S NOT JUST science-fiction writers. If you'd asked me in high school what I'd be doing right now, the answer would have involved far more jacuzzi time with Icelandic supermodels and far less answering questions in magazine columns. We all have fantasies, in other words, and few of us, whether we're sci-fi writers or hardware-store managers, see them come true in every particular.

But let's look specifically at the sci-fi genre: while every writer has his or her own process, a common creative approach is to identify a trend in science, society, or, ideally, both, and project it some dis-

tance into the future. The author must decide: what will the world look like, and when will it look that way?

Consider now that the sci-fi writer must devise a story and a setting people will find interesting – assuming he wishes to avoid a second career answering questions in magazines. Here he faces a catch-22. If the imagined world is too similar to contemporary reality, it may be insufficiently exotic to capture a reader's interest. On the other hand, if the story is set too far in the future – 2 000 years, say – it risks feeling too remote to care about. These twin imperatives dictate that writers pack

the maximum social and/or scientific change into the minimum plausible time span. The inevitable result is the almost universal tendency for "predictions" made in science fiction to fail to come true on time, if at all. Remember, though: sci-fi writers are seldom attempting to predict the future so much as they're trying to provoke thought by asking, What if? So cut 'em a break. You want Nostradamus, read Nostradamus.

How often do busy filling stations need a refill?

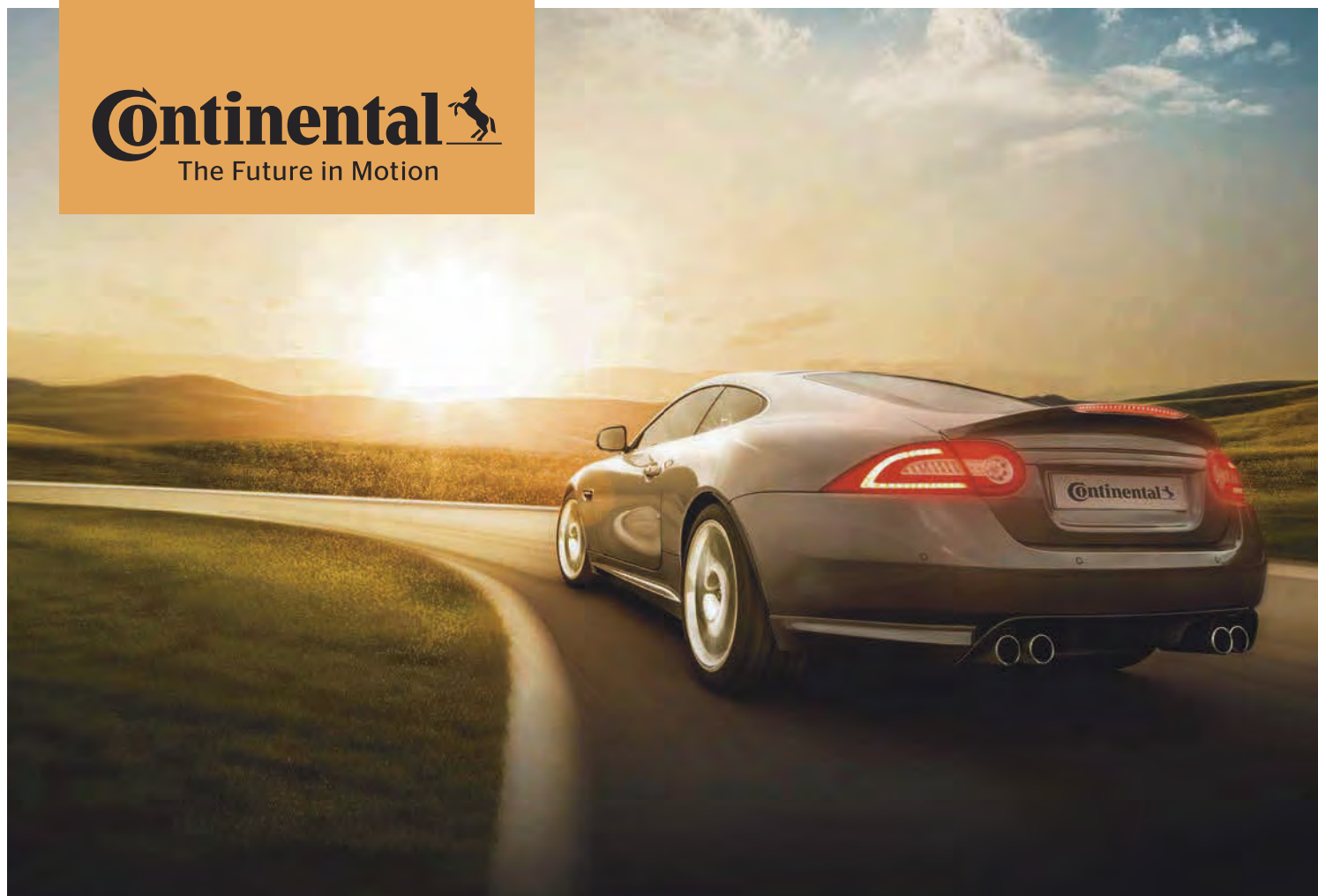
The average filling station dispenses between 11 000 and 15 000 litres a day. A typical station's underground tanks (usually two* – one for diesel, one for petrol) hold 30 000 to 45 000 litres total, which, according to the liquid-cooled supercomputer this magazine leases from NASA, means they require a delivery every... every... ding! – two to four days. An extremely busy station, on the perfect corner in Johannesburg, maybe, or associated with a discount store such as Game, might need to fill up once or even twice a day. Truck stops, though, are in a class by themselves. They can require refills as often as five times daily, and might pump as much as 4 000 000 litres of fuel a month, along with, one suspects, a similar amount of bad coffee.

How useful are those weird-looking police identikit of criminals, really?

Not very, it seems. Firstly, eyewitnesses are notoriously unreliable (according to an American study, incorrect identification played a role in 3 out of 4 wrongful convictions). Secondly, we're particularly bad at identifying individual features – even of a face we see daily – University of Cape Town psychology postdoctoral student Kate Kempen has found. Assembling a useful identikit from a library of noses, eyes and so forth is almost impossible. UCT's solution: a computer program that combines a library of faces with different elements to "breed" faces matching a witness's memory of a perpetrator.

* There are usually two grades at a pump, though.

PM



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GREAT STUFF



SAMSUNG SUHD TV

Digital splendour

When Samsung claimed that its revolutionary new curved SUHD TV delivered stunning contrast, striking brightness and spectacular colour, they weren't kidding.

At its heart is Samsung's proprietary nano-crystal technology, which delivers 64 times more colour expression than conventional TVs. This is supported by the intelligent SUHD remastering engine, which automatically analyses the brightness of images to minimise power consumption while expressing ultimate contrast levels.

Tizen, its open-source platform, provides a more intuitive user interface and various ways to access content. Smart Hub displays most recently viewed content, so you can pick up right where you left off. Once paired, Quick Connect automatically recognises any Samsung smartphones, allowing users to share content and even watch programmes from their mobile unit without any apps or complicated pre-settings. The range has three models, the JS9500, JS9000 and JS8500, in seven screen sizes varying from 55" to 88". Prices start at around R35 000 and top out at a whopping R300 000. Visit www.samsung.com





MOBILEYE 560

Sixth sense

On today's crowded roads, an extra pair of eyes would be a distinct advantage. It's unlikely we'll experience that kind of genetic mutation anytime soon, so it's been left to car companies to supply electronic systems to do the job of seeing what the driver can't. Until now, though, only the well heeled would have been able to enjoy this sort of thing in their Merc, Beemer or Volvo. But that's about to change. Mobileye, the company that provides the tech to the motor manufacturers, has put an aftermarket collision avoidance system within reach of ordinary

motorists. The hardware – a small windscreen-mounted camera and dash-mounted display – is plumbed into the car's wiring. Features include audible and visual alerts for lane departure, potential forward collision and pedestrian and cyclist detection, but there are plenty more options, including a Bluetooth smartphone app. Additional benefits include insurance discounts.

Price: R14 000 at approved fitment centres (finance options are available, too). Contact distributors AI Vision on 011-402 3483 or visit www.aivision.co.za



K-WAY MEN'S DRAKE ► DOWN JACKET

Kill the chill

K-Way's Men's Drake Down Jacket is so light it feels as though you're wearing air. But don't be fooled: thanks to its channel down design incorporating hypo-allergenic quality down (650 fill power), it keeps you toasty warm. Its 20D nylon outer shell is water-resistant, wind-proof and vapour-permeable. And when things hot up, you can stuff the jacket into its small inner pocket, making it convenient to stash in a bag. Price: about R1 300. Contact Cape Union Mart on 012-464 5800 or visit www.capeunionmart.co.za





MASTER LOCK EXCELL DISCUS COMBINATION

When security matters

It's not that bolt-cutters are inherently bad. But let's just say that they have acquired an unfortunately bad rep as the tool of choice for a certain class of non-law-abiding citizen. Well, according to the people at Master Lock, things have just got a lot tougher for the baddies.

The Combination Discus M40EURDNUM, part of Master Lock's 16-model Excell range, boasts a protective shrouded shackle that's said to offer superior resistance to bolt-cutters. And, if you plan to use it outside, be aware that the rust-free stainless steel construction provides good weather protection, too.

Master says its Excell is the first range of high security padlocks with pro-grade performance at consumer-grade prices. There are 16 models, in different sizes and shapes. A total of 40 patents have been filed, covering everything from product design to packaging and the manufacturing process. Features include a Tough-Cut octagonal boron-carbide shackle that's said to be 50 per cent harder than steel and nearly impossible to cut with bolt cutters, a protective cap for the combination, ball bearing locking for maximum pry resistance and a rubber bumper to protect surfaces from scratching. Price: about R340. Contact distributors IB McIntyre and Co 021-508 1250 or visit www.mackiediy.co.za



SENA PRISM MOTORCYCLE CAMERA

Film your ride

Want to film your next epic cross-country jaunt on your two-wheeled steed? Well, now you can. Sena's Prism motorcycle camera was designed specifically for motorcyclists. It comes with various mounts (helmet clamp, helmet surface, top surface, handlebar and suction cup), allowing you to place the camera virtually anywhere to add some creativity to your footage. Thanks to Bluetooth 4.1 connectivity, you can add your own dialogue (via the built-in mic, Bluetooth headsets or mics) and control the camera wirelessly via its remote. Even better, it comes with a quick-release mount system.

The camera measures 63 x 44 x 23 mm and weighs a mere 125 grams (including battery). It also features a water-resistant body (a 40 m waterproof housing is included), records Full HD video and shoots 5 megapixel stills. An adjustable time lapse mode lets you shoot a sequence of still photos at pre-determined times. The 1 100 mAh lithium-ion battery is good for around 2 hours of recording time and the camera can be operated while charging. Price: about R4 800. Contact Action Gear on 011-781 1323 or visit www.actiongear.co.za

APPLE MACBOOK 12-INCH

Go on, take a bite

Nothing says "My business is doing well" quite like a brand-new shiny Mac. Apple's latest 12-inch MacBook is no exception. Available in space grey, silver and gold and an anorexic 13,1 mm thick, this compact machine's going to look good, no matter where you use it.

Fitting a full-size keyboard into its compact frame required redesigning every key and its underlying mechanism. The end result: a keyboard that's thinner, while still allowing for more comfortable, precise and responsive typing.

The 12-inch Retina display, with its 2 304 x 1 440 resolution makes content pop out the screen – the rich, vibrant detail is something to behold. Hey, it's a Mac.

The trackpad has been upgraded, too. Engineered to deliver a responsive, uniform click no matter where you press the surface, it features force sensors to detect how much pressure is applied – providing you with extra ways to interact with your stuff. You also get haptic feedback that adds a sense of touch to what you see on the screen.

As the fifth-generation Intel Core M processor runs on just 5 watts of power and the OS has been optimised for efficiency, the system generates very little heat, so no fan is required. That means silent running. Plus the battery has an impressive runtime of about 9 hours. Price: R19 000 gets you the 1,1 GHz/8 GB memory/256 GB flash storage version. The higher-spec model, featuring 1,2 GHz/8 GB memory/ 512 GB flash storage, will set you back about R24 000. Visit www.apple.com/za



CANON 12 X 36 IS III ▲ BINOCULARS

Bring 'em near

Sport enthusiasts and birders looking for a well-balanced, durable and comfortable set of binoculars with great optics can't go wrong with Canon's new-and-improved 12 x 36 IS III. Replacing the 12 x 36 IS II, it features an active optical image stabiliser to steady the view while you're walking, in the back of a bumpy safari truck or in a hot-air balloon. Vari-angle prisms reduce handshake, steadying the subject to minimise eye strain (great for sport, where you don't want to miss any action). Plus, the image stabiliser can be activated immediately at the press of a button. Birders will appreciate the smooth panning support, which helps track birds in flight.

The soft-touch silicon rubber eyecups are extremely comfortable, and the binocs can be used with glasses, too. A set of AA batteries provides about 9 hours of stabilised viewing. Price: about R9 800. Contact Canon on 011-251 2400 or visit www.canon.co.za

GARMIN FENIX 3 GPS SPORT WATCH ▼

Start counting

Demanding athletes and crazy outdoor adventurers need a tough, can-do sportswatch. Garmin's latest GPS-enabled device, the Fenix 3, supports a full range of sport activities from advanced fitness training to trail running, swimming, cycling and even hiking. For everyday wear, it has activity tracking functionality, which provides a customised step goal each morning, then counts steps, calories and distance throughout the day. A vibrating alert nags you to get moving after an hour of inactivity, and a sleep mode monitors your rest.

The Fenix's Smart Notification feature allows you to pair your smartphone wirelessly to receive calls, text and email alerts right on your wrist, even if your phone is stashed away. Like its predecessors, it comes with a full navigational toolset, too. The steel EXO antenna picks up GPS and GLONASS satellites to achieve faster fixes. A barometer, auto-calibrating altimeter and 3-axis electronic compass are built in.

The battery provides for 20 hours in GPS mode, 50 hours in UltraTrac mode and up to six weeks in smart watch mode. Basic watch functions include alarms, tones, vibration alerts, timer and stopwatch. Price: about R7 600. Contact Garmin on 011-251 9999 or visit www.garmin.co.za



Editor's
choice



MR POWER DOMESTIC INVERTER ▲

Power up when it all goes down

Load shedding is good for many things: missing out on your favourite TV show, for one. Not being able to get any work done is another. Mr Power's UPS (uninterrupted power supply) range was designed to help homes and small businesses survive the load shedding periods of typically around 150 minutes as long as you respect what each model can handle.

All three models are "plug and play", operate automatically, can be fitted with different battery combinations and feature integrated charging systems. LED indicators show battery status, AC or battery modes.

The smallest 650 VA model can power up one TV or one desktop PC. The midrange 1 000 VA version can run a TV, decoder, DVD player and table lamp. Lastly, the big daddy 2 000 VA unit can run the same as the midrange model, plus a computer. Prices range from around R5 000 to R12 000. Contact Mr Power on 011-804 2988 or visit www.mrpower.co.za



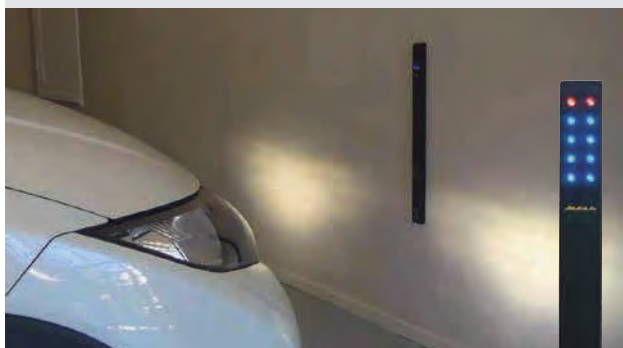
LED LENSER XEO 19R

Boss beam

Although the First Rule of Lighting says you can never have too many lumens, the LED Lenser XEO 19R pushes the envelope. With all of 2 000 lumens in output, *nobody* will be looking you in the eye. Besides being seriously bright, it's smart, too: two independently operated LEDs mean you can have any combination of flood and spot that you choose.

Three new features make their debut on the XEO: a USB charger and power bank for charging devices such as smartphones; Optisense, which optimises light output automatically depending on ambient conditions; and an air intake chamber to help keep the LEDs optimally cooled.

Included in the deal is a rechargeable Li-ion battery pack that provides enough charge for up to 40 hours of runtime. A dynamic control pad regulates modes and brightness. There are a variety of mounting accessories, including a belt clip and helmet and bike mounts. For the record, it's also IPX6 splashproof and carries a 5-year warranty. Price: R3 950. Contact Awesome Tools on 021-981 6672 or visit www.awesometools.co.za



PARKA ▲

Beat the bumps

Low-tech solutions to the problem of parking in a confined space include the time-honoured tennis ball-on-a-string method. You do have to remember, though, to adjust your hanging tennis ball if you happen to be parking a different vehicle (don't ask us how we know this). If you are after a rather more high-tech – read convenient – solution, look no further than the Parka. This LED device effectively puts Park Distance Control system, like the ones on-board in cars, on your garage wall. The Parka's two proximity sensors indicate how close you are by lighting up successively more blue LEDs until a row of red indicators shows you have reached your desired spot. You can park as close as 5 cm to the wall and calibrate at the touch of a button. Developed and made in South Africa, the Parka costs about R400. Contact inventor Jonathan McFarland on 082 332 7122 or visit www.parkacar.co.za



LINKSYS XAC1900 DUAL-BAND WI-FI MODEM ROUTER

Get connected

Those shopping for a seamlessly connected home network should check out Linksys' new XAC1900 Dual-Band Smart Wi-Fi Modem Router. First off, its built-in DSL modem makes it easy to connect to a DSL Internet service. Thanks to next-generation Wireless-AC tech it boasts dual-band speeds up to 4,3 times faster than Wireless-N. It also has three adjustable external antennas to optimise the Wi-Fi signal throughout the home, providing improved signal strength in those tricky blind spots.

Designed to sustain multiple devices and users, it offers simultaneous dual-band speeds of up to N600Mbps (2,4 GHz) + AC1300Mbps (5 GHz) – making it great for households who game online, stream high-definition media or who are looking for a quick Web experience. You also get software that allows you to manage your Wi-Fi access remotely by prioritising devices or Web sites, gain parental control over content, monitor network activity and create password-protected guest networks. Price: about R5 000. Visit www.linksys.com

PM



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WE PLAN AROUND IT. USE APPS TO KEEP US UPDATED ABOUT IT. AND, YES, COMPLAIN ENDLESSLY ABOUT IT.

MORE SOUTH AFRICANS CONNECTED TO THE NATIONAL GRID THAN EVER BEFORE
TO PONDER THE NEXT 150 MINUTES IN DARKNESS. YOU COULD
PM KIND OF THINKING. TURN THE PAGE FOR OUR 5-STEP PLAN

BEAT THE

LOAD SHEDDING. IT'S BECOME PART OF WHAT WE DO. THE PROUD BOAST OF HAVING RINGS MORE THAN A LITTLE HOLLOW. WHEN THE LIGHTS GO OUT, YOU COULD CHOOSE RAGE BY CANDLELIGHT. OR YOU COULD GET SMART - WHICH IS TO MANAGING THE DARK.

BLACKOUT

IMAGE BY POWEROPTIMAL/REGARDT VAN DER BERG

SURVIVING LOAD SHEDDING REQUIRES A STOIC ATTITUDE. AND THE RIGHT KIT. The spontaneous upwelling of outrage directed squarely at our national energy provider and those two dirty little words “load shedding” may have subsided, but that doesn’t mean any of us are happy with the state of our nation’s energy affairs. Fortunately, as has been proven many times in the past, South Africans tend to have great resolve. Realising that cold dinners, missed TV shows and bumping around in the dark are our collective reality for the next few years, households and businesses everywhere are furiously making plans to mitigate the inconvenience and loss of income that regular power outages bring. In fact, like everyone at PM, you’re most likely doing it yourself.

Here, then, is a 5-step guide in which we kick around some of the power solutions available today to lighten the load of load shedding and keep our lights on, then check out some promising battery tech we can expect to see in our homes in the not too distant future.

STEP 1: MANAGE IT Just sometimes, catering to your own self-interest can contribute to the greater good.

And saving electricity – especially during peak periods when it’s most expensive (and the grid closer to collapse) – is a perfect example. It’s a no-brainer. That’s because, when you use less power when it matters most, you not only save yourself hard cash up front, but help ease the load on the power network at the same time, too. That’s great news for all of us.

Electricity consumption and billing management solutions company PowerOptimal operates in this exact space. One of their home-grown products, PowerGuard, has a proven record: it’s managed to slash peak power demand by as much as a half. That translates into significantly reduced utility bills for their commercial clients.

“Our technology can help drive down peak power demand of households and businesses of any size,” explains Dr Sean Moolman, co-founder and CEO of PowerOptimal. “What it does is intelligent load shifting of non-essential loads, such as geysers, boilers, air conditioners and underfloor heating. It works in a way that substantial peak power reductions can be achieved without any impact or inconvenience to the end user.”

For domestic installations, PowerGuard components are mounted between the household power distribution box and as many appliances as required. The appliances can then be connected into a hard-coded hierarchy, which the user determines, specifying the relative importance of each one. You could rank your main bathroom geyser as most important, followed by the second geyser and so on down the line, for instance. This hierarchy determines which appliance is more deserving of electrical supply should more become available, or which one must shut down

Top: One of four 16-channel PowerGuard receivers controlling an array of boilers at a hotel, which reduced the hotel’s peak demand by around 20 per cent.

Middle: The installation of three 8-channel PowerGuard domestic demand controllers resolved severe power tripping problems from an upmarket Gauteng home.

Bottom: This large Gauteng residence was designed for a 150 A power supply, but the municipality made only 80 A available. PowerGuard has enabled this home to operate with reduced power supply for the past four years.



first when power becomes constrained.

PowerOptimal’s tech also works for larger homes cursed with serious supply constraints, the source of frequent power trips. Just by managing the load, it can completely eliminate those irritating treks down the passage to the main board. It can also automatically switch between different load profiles such as generators or inverters. When a power failure occurs, the system immediately switches to the backup load profile, then switches off appliances and equipment to ensure demand stays within the available supply. When the power eventually comes back on, PowerGuard first waits to make sure the power supply is stable. Only then does it begin switching on appliances in a staggered manner, ensuring that demand stays within the available supply. (www.poweroptimal.com)

Load shedding 101

What is load shedding?

When there is not enough electricity available to meet demand, supply to certain areas is interrupted.

Why loadshedding?

Rotating and shedding the load in a controlled way helps keep the system stable to avoid collapse of the electricity supply grid (a national black-out). If this occurs, it could take more than a week to restore power to the entire country.

What are the alternatives?

Certain large customers in mining and industry are asked to reduce their demand.

Who is affected?

Eskom's National Control Centre instructs

its Distribution Regional Control Centres, 126 Municipalities and Eskom's key Industrial Customers on the amount of Megawatts to be shed.

When is it most likely?

The national power system is particularly strained during the evening peak between 5 pm and 9 pm in winter, and at any time of the day in summer.

How much load needs to be shed?

Stage 1: up to 1 000 MW

Stage 2: up to 2 000 MW of the national load to be shed.

Stage 3: up to 3000 MW

Stage 4: up to 4000 MW

For how long?

Two hours at a time, plus half an hour for switching.

What can consumers do?

Follow 4 actions for 4 hours:

- Switch off your geysers, electric heaters and pool pumps from 5 pm to 9 pm
- Switch off unnecessary appliances and lighting
- Use alternative heating solutions
- Respond the Power Alerts and Power Bulletin updates

Source: Eskom. Find out more:

0860037566/08600ESKOM, loadshedding.eskom.co.za or your local authority

STEP 2: PICK YOUR BACKUP Okay, so you've managed to bring your home or business's power usage right down, but the lights still go out. Sure, you can opt for a small generator to run a few critical appliances. However, it must be said, domestic generators are becoming quite a nuisance in communities where close proximity to one's neighbours is an issue. In fact, you don't have to try too hard to find some outraged body corporate protesting against all the noise pollution. So, if you opt for this route, tread warily.

That's assuming you can actually lay your hands on a generator. As winter 2015 finally began biting, all you had to do was phone a dealership and ask about purchasing one to be greeted by a response that verged on hysterical laughter. Stock has been flying off shelves so fast no one – and that includes the big retail players – could keep up. Established dealerships were having to import containerloads of stock directly themselves, in their attempts to keep up with demand. Bottom line: generators work, but if you want one, get a quiet model and be prepared to add your name to a waiting list and slap down a deposit.

What about inverters? They're quiet, effective over shorter load shedding periods and a system can be cobbled together for surprisingly reasonable money. See "On the (relatively) cheap" for the story of how one man did it without breaking the bank.

STEP 3: CONSIDER GAS If you want to power your home as if its copper umbilical cord were still sucking nutrients from the national grid, then a dedicated domestic gas-powered generator is your most economical, convenient choice. Johannesburg-based standby power specialists Bundu Power stocks a range of Generac Guardian Series gas generators imported from the United States that fit the bill perfectly.

Costing around the same amount as a quality brand 5,5 kVA liquid fuel generator (or about R45 300), their 8 kVA Guardian Series unit (model BP8S-G) will have no hassles powering up the average home in its entirety. It also comes in a not unaesthetically pleasing weatherproof housing that wouldn't seem out of place even in the most manicured of backyards. Able to run on bottled LPG or piped natural gas, it's a great option for those living in and around the Johannesburg area with piped gas amenities.

Automatically kicking in within seconds of a power outage is just one of the Guardian Series' advantages. Generac's OHVI engine is purpose-built for the rigours of generator use, so requires considerably fewer scheduled maintenance check-ups than competitive engines – requiring only 200 hour/2 year service intervals. It also burns much less fuel than its petrol or diesel cousins, making it more economical to run.

Honda's inverter generators, the 5,5 kVA EU65is (price: about R46 900) and the 1,6 kVA EU20is (price about R13 700) both work for home use – if you can find one due to the high demand, that is.

Below: Generac's 8 kVA Guardian Series gas generator (price: about R45 300) runs on either LPG or natural gas, requires minimal maintenance and operates completely automatically.



The unit's sturdy enclosure can withstand winds of up to 240 km/h, and boasts a fire rating that allows for installations as close as 46 cm to a home. Convenient at-a-glance indicator lights make it easy to check the generator's status without having to open the enclosure up. Plus, all the generators in the range automatically self-test themselves once a week at low RPM to ensure everything is still in good working order.

One caveat: installation of a gas generator adds some extra cost. "You need to have a qualified gas installer as well as an electrician to do the installation," says Bundu Power's Nick von Broembsen. Once done, they will need to issue certificates for insurance purposes. "When installing a diesel generator you need only a qualified electrician," says Von Broembsen. (www.bundu-power.co.za)

STEP 4. CONSIDER SUSTAINABILITY

If all you want is to keep on a light or two, watch some TV, use your laptop a bit and charge a couple of phones, then something like the Ecoboxx 600 portable solar generator could be your answer. Costing about R13 000 (or about the same as a small, silent-running camping generator), it comes with none of the maintenance and safety hassles of its fossil-fuelled equivalent. That it can run a 42-inch TV and decoder for 3,5 hours should give you an idea as to its capacity.

Components include four 10 W solar panels, two 600 W AC pure sine wave outlets, two 5 V DC USB ports, two 12 V DL DC jack outputs and a 42 Ah AGM battery. It also comes with an AC/DC wall charger and a travel trolley to help you move it around. Charging from the mains takes roughly 2 – 3 hours; solar charging times depend on the weather (on average, it's said to require one day of direct sunlight to fully charge). Ecoboxx units also come in a range of capacities, so finding one that fits your specific needs shouldn't be a problem. (www.ecoboxx.co.za)



Ecoboxx offers a range of portable solar generators, making them great options for those just wanting to watch TV or work on their PCs during load shedding. The Ecoboxx 600, featured above (price: about R13 000) can run a 42-inch TV and decoder for 3,5 hours.

STEP 5. BE ADVENTUROUS Tesla's domestic lithium-ion battery, the Powerwall may be hitting the shelves globally only in 2016 (and only around the end of that year in SA), but that didn't prevent its recent global unveiling from causing an international sensation. When the Powerwall (available in 10 kWh and 7 kWh capacities) eventually lands on our shores, it could be the answer for many cash-flush suburbanites seeking a pragmatic release from the grip of load shedding.

Inside each Powerwall you'll find Tesla's lithium-ion battery pack, a liquid thermal control system and software that receives dispatch commands from a solar inverter. The batteries pair with a number of readily available inverters, and the list is growing, fast. Units (measuring 130 cm x 86 cm x 18 cm, and weighing 100 kg) mount seamlessly on walls, and are integrated with the local grid to harness excess power and give users the flexibility to draw energy from their own reserve.

The 10 kWh unit (ideally only cycled once a week) has been optimised to provide backup when the grid goes down, feeding power to your home when you need it most. When paired with solar power, the 7 kWh model can be used in daily cycling to extend the environmental and cost benefits of solar into the night when sunlight is unavailable. That said, at the end of the day, both versions can provide backup power.

Their announced prices (about R42 000 for the 10 kWh version and around R36 000 for the 7 kWh model) also caused a fair bit of excitement. But, before you get too enthusiastic, consider this: these prices don't include import duties or tax, an inverter (good ones don't come cheap) or installation. So bank on spending plenty more than what it says on the brochure. On the upside, they do come with a 10-year warranty. (www.teslamotors.com)

Tesla's Powerwall is anticipated to land in SA only by the end of 2016; when it does it'll provide great backup power for affluent homeowners. We don't expect this to be the last word on alternative energy from Tesla's ever-inventive Elon Musk (left), either...



On the (relatively) cheap

The poor man's guide to pushing back the darkness, staying up with soapies and working uninterrupted. Keeping the frosties cool? That's another story. BY CHRIS CLARKE

THE TERM **LOAD SHEDDING** reminds me of a black Border Collie we looked after while his mistress went overseas for a month. It shed hair prodigiously (the dog, that is). This became very apparent when, on day two, we came home and Mr Collie did not greet us as usual. He had, instead, found a much more cosy place: inside our bed. Naturally, there was a layer of stinking, wet black dog hair everywhere. He was clearly looking for someplace warm after his swim, poor thing.

But I digress. In the past, we have had the occasional power failure. That's when you realise how useless candles are at providing meaningful light for anything except 19th-century pursuits such as knitting and playing cards. Even a bank of 10 candles hardly makes a dent in the gloom. Besides, transporting them to another room is a hazard: hot wax to spill down your leg, invisible dog or cat to trip you up, house to burn down...

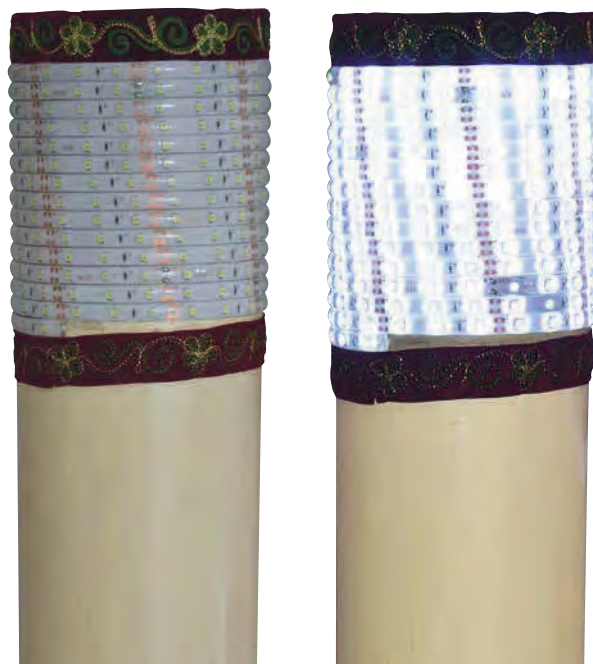
You could buy rechargeable fluorescent lights at hardware shops. You know the kind: when new, they work fairly well and you could manage to read a newspaper if it was close enough. Sadly, 12 months unused in a cupboard simply causes their demise. The battery runs down (a fluorescent tube needs a "kick-start" of a large current to start. An old battery won't do the trick). About one in ten of these lights would recover when charged up. I once had the brainwave of changing the battery inside (usually 6 volt 4 amp). Finding the batteries wasn't too difficult, at about R80 a pop. But undoing the self-tapping screws from a flimsily constructed contraption usually resulted in 6 of the 10 studs breaking off inside. I had to resort to cable-ties to preventing the innards falling out as if recently de-gutted.

So when Eskom's forecast – one of its more believable forecasts – of regular load shedding became a reality, I looked for a more reliable solution. Being a DIY type, I designed it myself.

Our local China-Town mall was a good place to start. That's where I found a 5-metre strip containing 490 white LEDs, all embedded in a strong and flexible rope with an adhesive backing. At R200, it seemed a relative bargain. Connected to a 12-volt battery it provides an excellent light source – more than enough to read by. To make it look more presentable, I wound the strip around a 110 mm drain pipe. At this stage it was functional, but still somewhat lacking aesthetically, so I glued a decorative strip at the top and bottom. In a rush of enthusiasm, I added a further 5-metre strip of lights underneath and an on/off switch. Being a wide tube, it stands up by itself on a table.

The main benefit of LEDs is efficiency. They are more efficient (25 lumens per watt) than most fluorescent tubes in converting electricity to light. However, LEDs like operating from a supply of under 2 volts. To operate them with 12 volts, you need a resistor in front of the LED. Overload the LED and its life shortens drastically. As in, instant expiry. The light strip I described above has the resistance built in. Another requirement of LEDs is that they operate from DC, which is provided by a battery.

Now, 490 LEDs might sound a lot to power at once. Using an old burglar-alarm battery that had some life left in it, I calculated that the whole 5-metre strip would deplete the battery by only 20 per cent over a 3-hour period. In practice, the battery on switch-on measured 13,5 volts and, at the end of 3 hours, measured 11,5 volts. Connecting this to a battery charger made it recover in about 4 hours. Beware: running LEDs for very long periods shortens their life, as the semiconductor junctions in



Take one offcut of 110 mm PVC pipe, wrap around it one 5-metre strip of LEDs from the local China Town mall and voila - low-energy lighting that's kind to the budget. And with a little imagination, you can doll it up to look slightly less industrial (see text).

the devices can get hot.

That's the light story done and dusted, then. How much did it cost? For me, not much: I had to buy the LED strips, but I had the battery lying around and the drain pipe scrounged from a friend. You might have to get a battery charger and even a 12 volt 7,0 Ah battery, which can set you back R 400 or so. Being a gel-type battery and not stressed and kept at room temperature, though, it can last 8 years.

Now that I could see what I was doing, I began to get ideas. What about a TV and a satellite receiver? While we're at it, an amp and speakers to make it sound nice? And – I almost forgot – a PC or a laptop?

You must realise that, with the "flea-power" devices I am going to describe to run these items, there will never be enough power to cook, make hot water or even run the fridge (and no toast either). Fortunately, electronic devices are generally efficient; you don't have to build your own power station and have a dedicated coal or diesel supply.

Let me state upfront that I don't like internal combustion engine generators. They are generally noisy, get hot and smell and cost a whack to run. They must also be maintained, just like a petrol-powered mower. I prefer the electronic solution. It's much more elegant and, over time, cheaper. Admittedly, if you have a fridge or freezer-full of crayfish, then you might consider getting a generator.

The first thing you need to do is sit down and make a list of the bare minimum of your electronic devices you absolutely need, and how much electricity they require in watts. The easy

way to do this is to look at the sticker on the back, or even in the user manual – you did keep it, didn't you? The table alongside gives you an idea.

Let's assume that you want to run the items listed in the table for 3 hours; $3 \times 288 \text{ watts} = 864 \text{ watt/hours}$. At 220 volts, this is about 1,3 amps over the 3-hour period.

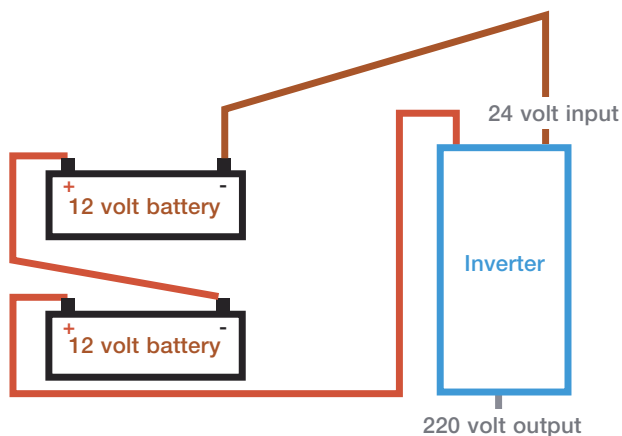
I am going to suggest you use an inverter to convert battery power to 220 volt mains power. It's assumed that you are capable of connecting a multi-plug to it and safely connecting the devices described here without causing too much of a hazard.

As you might have realised, drawing 24 amps out of an old alarm battery rated at 7 a/h does not make sense. It would be all over and darkness would descend in minutes. What you need is a larger battery. Much, much larger. And here comes the expense.

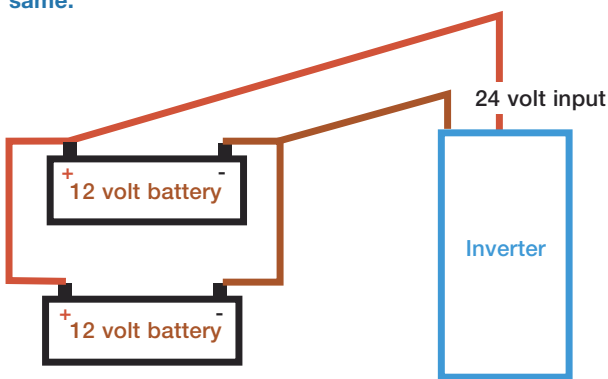
Not only do you need this larger battery, you also need a decent charger with "intelligence". That means it has to be capable of replenishing the current you have drawn from the battery fairly quickly and stopping the charge when the battery is full. That way, it prevents overheating and consequent shortening of the battery's useful life.

A typical DIY inverter installation

An inverter with a DC input of 24 volts is more efficient at converting CD to AC than a 12 volt unit since the upwards multiplication is smaller. Less current (amps) is drawn from the batteries, the cable can be thinner and a less expensive transformer can be used.



These two batteries are wired in **SERIES**. This doubles the **VOLTAGE**, but the available current stays the same.



These two batteries are wired in **PARALLEL**. This voltage stays the same, but the available **CURRENT** doubles.

Watt's it worth?

DSTV decoder **25 watts**

Newish flat screen TV up to about 46 inches diagonal screen **130 watts**

Home theatre amplifier, not turned up too loud **100 watts**

If you insist on some lighting, then say 3 x 11 watt CFL lamps **33 watts**

Suppliers

Ballpark figure for system as outlined in text **R8 000**

Inverter Mantech Electronics

Charger Mantech Electronics

XLR connector Yebo Electronics

Digital meter Makro

Battery Local supplier preferred (very heavy = expensive to ship). In Cape Town's southern suburbs, where I live, Plumstead Hardware on Main Road stock large batteries at a relatively affordable price.



Most inverters are about 90 per cent efficient. In other words, to create 864 watts over a 3-hour period, they must draw about 960 watts from the battery. Likewise, batteries are 80 per cent efficient. This results in you having to replace 1 080 watts of electricity into the battery to get it back to the state in which it was before you used it.

Now, what about your PC? A modern computer and a flat screen consume no more than 300 watts. Add to this a router (20 watts) and you have a very similar power consumption to the TV system.

I would suggest a separate battery/inverter for each system, but connected to just one battery charger.

Today you can get smart 12-volt battery chargers for about R800. One I selected at random provides a 7 amp output, sufficient to recharge a large battery in 4 hours. They come with an XLR type of plug; you can wire up a female XLR plug to your battery(ies) so you can swop the batteries to the charger. It is important that you use a connector capable of 7 amps and an XLR connector has pins and sockets that are rated above that current.

Now, how to choose from the bewildering variety of batteries on sale. Still the most economical is a lead-acid type of battery. This can be wet cell (you open up the cap of the battery to check the level of electrolyte in each pair of cells) or a gel type. Gel

types are tidier and there is no mess. Nowadays, also, they are good value. For sheer long life and the ability to draw current over a long period, a wet-cell design is better. There is an argument pro and con for both types.

For the power requirement scenario described above, the minimum should be 55 amp-hours, but 100 is recommended. For longer power outages you will obviously need more battery power, but there is no problem about attaching a second or third battery to the system, provided that you keep the charging device within its capabilities. A charger with a small current capability will take longer to charge the batteries, depending on how discharged they are.

One important thing to bear in mind is that lead-acid batteries specify a "charge-discharge" cycle. This number is limited. Due to chemical action, you can charge and discharge a battery only a finite number of times before it will no longer hold a charge effectively. A wet-cell battery is more forgiving about this figure; and 8 years of weekly charges is the norm.

Finally, it's wise to invest in an inexpensive digital multimeter to accurately read the voltage present at the batteries. This will prevent them from getting too low and presenting an excessive load to the charger. Around 11,3 volts is as low as it should safely go.

PM

LOCALLY PRODUCED LITHIUM-ION BATTERIES GET A STEP CLOSER



Chemical engineer Lunfeng Huang, a member of the University of Western Cape's lithium-ion battery research team, monitors the anode fabrication process at the university's small production plant. According to department head Professor Ben Bladergroen, if all goes well, South Africa could be manufacturing our own lithium-ion batteries within the next five years.

HUBBLE

25

turns

The most significant advance in astronomy since Galileo's telescope continues to provide humankind with ever more insights into the Cosmos. Here's a selection from NASA's pick of a quarter-century of truly amazing images

The most famous scientific instrument ever built, it's been called. Few would disagree. For 25 years the Hubble Telescope has allowed us to peer across space and time into the dawn of our Galaxy's creation. The quest to find our origins is far from over – but Hubble, more than any other, has taken us tantalisingly close.

Of course, it wasn't all plain sailing. Or orbiting.

Named after astronomer Edwin Hubble, who discovered the expanding Universe, the orbiting telescope nearly didn't make it to the launch pad. And when it did eventually soar into the sky that April day in 1990, it turned out that it had a catastrophic flaw in its primary mirror. It was, in effect, grievously visually impaired.

But the hurdles were overcome. It's been a remarkable journey that has produced some penetrating insights and some quite astonishingly haunting images thanks to the most significant advance in astronomy since Galileo's telescope.

The unimpeded view afforded by a platform orbiting in space, undistorted by Earth's atmosphere, allowed astrono-

mers to be better able to piece together the formation of structure in the universe. Which doesn't mean that ground-based telescopes suddenly became redundant: working together, using existing installations and computer simulations, a much clearer picture emerged of how the universe evolved from its initial hot, formless state 13,7 billion years ago to its present state where complex structure exists everywhere, some of it capable of supporting life.

Although NASA-driven, the Hubble Space Telescope is a project of international co-operation between NASA and the European Space Agency. NASA's Goddard Space Flight Centre in Greenbelt, Maryland, manages the telescope and the Space Telescope Science Institute (STScI) in Baltimore, Maryland, conducts Hubble science operations.

What happens next?

Like most things – except perhaps certain A-list celebrities – Hubble will increasingly start to show signs of age. Its components will degrade, the telescope will stop working and our faithful eye in the sky will soldier on until its orbit decays and it starts a death spiral towards Earth.

The original plan was to bring Hubble back to Earth for museum display, but it was designed to work with the space shuttle. With the ending of the space shuttle programme, there isn't a suitable vehicle to collect it. It's thought that a robotic mission will help de-orbit Hubble, guiding its remains through a plunge through the atmosphere and into the ocean. Perhaps that's the way to go. Not as a museum piece, gawked at by tourists, but rather in a last, triumphant, blaze of glory.

Sources: hubblesite.org, NASA/ STScI



EDWIN HUBBLE

2,5-metre Hooker Telescope begins operations at Mt Wilson Observatory in Pasadena, California. With this telescope in the 1920s, astronomer Edwin Hubble measured the distances and velocities of galaxies, work that led to his discovery of the expanding Universe.

1918

1923



A SPACE TELESCOPE

Famed rocket scientist Herman Oberth publishes an article speculating on telescopes in orbit.

10 HUBBLE FACTS

- 1** On 24 April 1990, the space shuttle *Discovery* lifted off from Kennedy Space Centre with Hubble aboard.
- 2** More than 1,2 million observations have been made and astronomers using Hubble data have published more than 12 800 scientific papers.
- 3** Hubble has travelled about 5 billion kilometres while orbiting the Earth about 550 kilometres up at roughly 27 000 km/h.
- 4** To change pointing angles, Hubble uses Newton's third law by spinning its wheels in the opposite direction. It turns at about the speed of a minute hand on a clock, taking 15 minutes to turn 90 degrees. It has no thrusters. Pointing accuracy is ,007 arc seconds, which is like being able to shine a laser beam on a R1 coin 300 kilometres miles away.
- 5** Outside the haze of our atmosphere, Hubble can see astronomical objects with an angular size of 0,05 arc seconds, which is like seeing a pair of fireflies in Sydney from Cape Town.
- 6** Hubble has peered back into the very distant past, to locations more than 13,4 billion light years from Earth.
- 7** The Hubble archive contains more than 100 terabytes, and Hubble science data processing generates about 10 terabytes of new archive data per year.
- 8** Hubble weighed about 11 000 kilograms at launch. Since the final servicing mission in 2009, it weighs about 12 250 kilograms – as much as two full-grown elephants.
- 9** Hubble's primary mirror is 2,4 metres across – smaller than big Earth-mounted mirrors, but unhindered by Earth's atmosphere.
- 10** Hubble is 13,3 metres long – about as long as a bus.



“Of course, it wasn't all plain sailing. Or orbiting.”



THE LST

Astrophysicist Lyman Spitzer gathered the support of other astronomers for a “large orbital telescope”.

SPACE TELESCOPE SCIENCE INSTITUTE (STSCI)

Operations begin in Baltimore, Maryland. The STSCI was built as the astronomical research centre for the Hubble Space Telescope.

SERVICING MISSION 1

Corrective Optics Space Telescope Axial Replacement (a complex packaging of five optical mirror pairs) installed, replacing High Speed Photometer (HSP) to correct a spherical aberration in the primary mirror.

SERVICING MISSION 3A

Work includes new gyros, new computer 20x faster and with 6x more memory and replacement of original reel-to-reel data recorder with digital solid state recorder that can store 10 times as much data, more reliably.

SERVICING MISSION 2

COSTAR removed and replaced with Cosmic Origins Spectrograph (COS).

1969

1977

1981

1990

1993

1997

1998

1999

2002

2009

FUNDING – AND NAMING – APPROVED

NASA names its largest, most complex, and capable orbiting telescope in honour of Edwin Hubble.

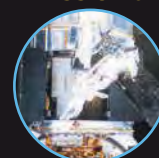
HUBBLE SPACE TELESCOPE DEPLOYED

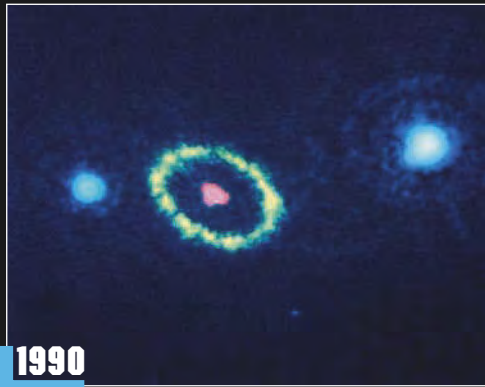
SERVICING MISSION 2

HST ORBITAL SYSTEMS TEST

New technologies for installation into Hubble during servicing missions 3A and 3B.

SERVICING MISSION 3B





1990



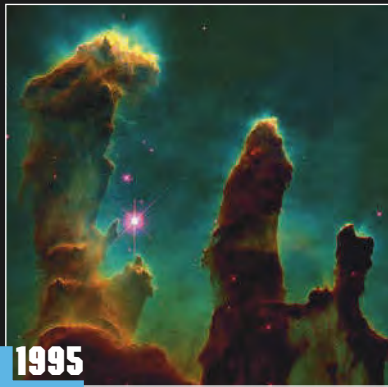
1991



1993

Main image 1992: A “true colour” mosaic image of a small portion of the Orion Nebula, 1,29 light-years across, taken with the Wide Field and Planetary Camera, showing a wealth of detail never seen before in the nebula. Above, left to right: **1990:** In unprecedented detail of 0,1 arc second, this is a mysterious elliptical ring of material around the remnants of Supernova 1987A. This raw image was not computer reconstructed; the blue and red colour was added to reflect the object’s true colour. The ring, located 160 000 light-years from Earth, is destined to be a relatively short-lived structure. Expanding debris from the supernova will overtake and disintegrate the ring within a century. **1991:** The best look yet at the disc of material that surrounds and is being pulled into a suspected black hole. The disc is at the core of a galaxy in the Virgo Cluster 45 million light-years from Earth. **1993:** A small portion of the Cygnus Loop supernova remnant. The Cygnus Loop marks the edge of a bubble-like, expanding blast wave from a colossal stellar explosion that occurred about 15 000 years ago.

PHOTOGRAPHS BY: MAIN PIC 1992: (CR O'DELL (RICE UNIVERSITY), NASA) 2000: (NASA/ANDREW FRUCHTER AND THE ERO TEAM (SYLVIA BAGGETT/STSCI, RICHARD HOOK/ST-ECF, ZOLTAN LEVAY/STSCI) 1990: (NASA/ESA/STSCI) 1996: (ROBERT WILLIAMS AND THE HUBBLE DEEP FIELD TEAM/STSCI/NASA) 1998: (G FRITZ BENEDICT, ANDREW HOWELL, INGER JORGENSEN, DAVID CHAPPELL (UNIVERSITY OF TEXAS), JEFFERY KENNEY (YALE UNIVERSITY) AND BEVERLY J SMITH (UNIVERSITY OF COLORADO, NASA).



1994 (Before and after): this comparison image of the core of galaxy M100 shows the dramatic improvement in the Hubble telescope's view of the universe. The picture clearly shows faint structures as small as 30 light-years across in a galaxy tens of millions of light-years away. **1995:** These eerie, dark pillar-like structures are actually columns of cool interstellar hydrogen gas and dust that are also incubators for new stars. They are part of the "Eagle Nebula", a nearby star-forming region 6 500 light-years away in the constellation Serpens. **1996:** Several hundred never-before-seen galaxies are visible in this "deepest-ever" view of the universe, assembled from many separate exposures, called the Hubble Deep Field (HDF), which represents a narrow "keyhole"

view all the way to the visible horizon of the universe. **1998:** A close-up view of the galaxy's core. The bluish-purple clumps that form the ring are the clusters of infant stars. Gas is trapped inside the ring through the stars' gravitational attraction.



1999: This image of Mars is centred near the location of the Pathfinder landing site. Visible are the massive Martian canyon systems of Valles Marineris, some of which form long linear markings that were once thought to be canals.

2000: A planetary nebula that began forming about 10 000 years ago, this is the glowing remains of a dying, Sun-like star about 5 000 light-years from Earth in the constellation Gemini. First spied by William Herschel in 1787, it is nicknamed the "Eskimo" Nebula because, when viewed through ground-based telescopes, it resembles a face surrounded by a fur parka.

5 LANDMARK FINDINGS

How galaxies evolve

Hubble's most famous distant view is the Hubble Deep Field, a tiny speck of sky that revealed a zoo of about 3 000 galaxies, some as old as 10 billion years. It has become one of the most studied regions of the sky.

Hubble's observations of deep space indicate that the young cosmos was filled with much smaller and more irregularly shaped galaxies than those that astronomers see in our nearby universe.

The Universe is speeding up

By examining the glow from a star that died 10 billion years ago, a supernova called 1997ff, astronomers collected the first observational evidence that gravity began slowing down the universe's expansion after the Big Bang. The finding, made in 2001, reinforces the startling idea that the universe only recently began speeding up, a discovery made in 1998 when the unusually dim light of several distant supernovas suggested that the universe is expanding more quickly than it has in the past.

The Universe is around 13 billion years old

In May 1999, a team of astronomers announced that they had obtained a value for the Hubble constant, an essential ingredient needed to determine the age, size, and fate of the universe. In April 2002, another team narrowed this down to between 12 and 13 billion years.

Black holes exist

In 1994, the telescope provided decisive spectroscopic evidence that supermassive black holes exist. Supermassive black holes are compact "monsters" that are millions or billions of times more massive than our Sun and gobble up anything – even light.

How planets are formed

The Hubble telescope provided visual proof that pancake-shaped dust discs around young stars are common, suggesting that the raw material for planet formation is in place. Scientists believe that the Earth and other planets of the solar system were formed out of similar discs about 4,5 billion years ago by the coalescing of matter caused by gravitational attraction.



Main image 2004: This composite image is a view of the colourful Helix Nebula taken with the Advanced Camera for Surveys aboard Hubble and the Mosaic II Camera on the 4-metre telescope at Cerro Tololo Inter-American Observatory in Chile. The object is so large that both telescopes were needed to capture a complete view. The Helix is a planetary nebula, the glowing gaseous envelope expelled by a dying, Sun-like star. **2001:** An unusual edge-on galaxy, ESO 510-G13, revealing remarkable details of its warped dusty disc and showing how colliding galaxies spawn the formation of new generations of stars. The strong warping of the disc by gravitational forces indicates a recent collision with a nearby galaxy, which it is in the process of swallowing. **2002:** Dubbed the “Tadpole”, this spiral galaxy (UGC 10214) was distorted by a compact blue galaxy visible in the upper left corner of the more massive Tadpole. Strong gravitational forces from the interaction created the long tail of debris, consisting of stars and gas that stretch out more than 280 000 light-years.

EYES THAT SEE IN THE DARK

Wide Field Camera (WFC3)

One of Hubble’s newest instruments, it’s able to see near-ultraviolet, visible and near-infrared light and used to study dark energy and dark matter, the formation of individual stars and the discovery of extremely remote galaxies previously beyond Hubble’s vision.

Cosmic Origins Spectrograph (COS)

Separates light from the cosmos into its component colors to provide a wavelength “fingerprint” of the object being observed, which tells us about its temperature, chemical composition, density, and motion.

Advanced Camera for Surveys

Sees visible light, and is designed to study some of the earliest activity in the universe.

Space Telescope Imaging Spectrograph (STIS)

Known for its ability to hunt black holes.

Near Infrared Camera and Multi-Object Spectrometer (NICMOS)

Hubble’s heat sensor, it is able to observe objects hidden by interstellar dust.

Fine Guidance Sensors (FGS)

Lock on to “guide stars” and keep Hubble pointed in the right direction.

PM



2003



2010

2003: A dull star (V838 Monocerotis) in an obscure constellation suddenly became 600 000 times more luminous than our Sun, temporarily making it the brightest star in the Milky Way. Although it's long since faded back to obscurity, observations of a phenomenon called a "light echo" around the star have uncovered remarkable new features that promise to provide astronomers with a CAT-scan-like probe. **2010:** A small portion of one of the largest seen star-birth regions in the galaxy, the Carina Nebula. Towers of cool hydrogen laced with dust rise from the wall of the nebula. The scene is reminiscent of Hubble's classic "Pillars of Creation" image from 1995, but is even more striking in appearance.



2005



2008



2013

2005: The graceful, winding arms of the majestic galaxy M51 (NGC 5194) are actually long lanes of stars and gas laced with dust. The galaxy, nicknamed the Whirlpool because of its swirling structure, is located 31 million light-years away in the constellation Canes Venatici (the Hunting Dogs). **2008:** Arp 148 is the staggering aftermath of an encounter between two galaxies, resulting in a ring-shaped galaxy and a long-tailed companion. **2013:** The Horsehead Nebula, discovered over a century ago, is a favourite target for astronomers. In this new Hubble view, the nebula appears in a new light, as seen in infrared wavelengths.

PHOTOGRAPHS BY: MAIN PIC 2004: (NASA/ESA/CR O'DELL/VANDERBILT UNIVERSITY, M MEIXNER AND P MCCULLOUGH/STSCI) 2001: (NASA, ESA, THE HUBBLE HERITAGE TEAM, C CONSELICE (U WISCONSIN/STSCI) 2002: (NASA, H FORD/JHU, G ILLINGWORTH/USC LO, M CLAMPIN/STSCI, G HARTIG/STSCI, THE ACS SCIENCE TEAM AND ESA) 2005: (NASA, ESA, S BECKWITH/STSCI AND THE HUBBLE HERITAGE TEAM) 2008: (NASA, ESA, THE HUBBLE HERITAGE (STSCI/AURA)-ESA/HUBBLE COLLABORATION AND A EVANS (UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE/NRAO/STONY BROOK UNIVERSITY) 2013: (NASA, ESA AND THE HUBBLE HERITAGE TEAM (STSCI/AURA)

WHEELS



Compiled by
ANTHONY DOMAN
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LAND ROVER DISCOVERY SPORT AIMING FOR THE SWEET SPOT

The Discovery Sport is the first fruits of Land Rover's decision to split its product line into three distinct "ranges". From now on, the Defender represents utility, the Range Rover represents the pinnacle of refinement and the Discovery will be the flag-bearer for design and engineering versatility.

The Discovery Sport differs markedly from the current Discovery. Visually it's a lot closer to the Range Rover Evoque than the current Discovery and conceptually leans more towards the Freelander.

The Freelander? No, the Discovery Sport is not a replacement. The Freelander has served its time, says Land Rover, although clearly the new vehicle fits into the gap left by the old one's departure. Whether future Discovery Sports – or whatever they are called – will be more their own vehicle remains to be seen.

The South African launch of the Discovery Sport took place over two days in the Southern Cape, in terrain that showed up all that's good about the car. Which is to say, pretty much everything. Its clever 5+2 design puts it immediately ahead of anything else in its size category and its off-road abilities are unrivalled among crossovers. That said, perhaps one or two rivals could claim sharper on-road handling and a quieter ride – and does one really need extreme off-road ability in a vehicle of this sort, anyway?

Our launch route took in some memorable mountain passes on tar and gravel, the Montague, Swartberg and Meiringspoort included. The 9-speed automatic gearbox is the first of its kind in a vehicle of this type and its unobtrusive contribution to proceedings is an indication of how well it blends into the overall picture. In combination with the 2.2-litre turbodiesel, available in two output variants, the result is a powertrain that feels surprisingly refined. (Jaguar Land Rover's new Ingenium diesel will be slotted into the line-up in due course.)

Of course, Land Rover's proven Terrain Response traction system enables the driver to dial up a driving mode optimised for specific conditions, such as sand, gravel, rock or snow. The Discovery Sport never put a wheel wrong, even in some pretty dodgy conditions. The ride on heavily rutted gravel roads, in particular, was simply superb.

One eye-opening demonstration – of the "don't try this at home" variety – had us being guided around a rocky course at what appeared to have been part of the original watercourse at the base of the Kamanassie Dam Wall. The Discovery Sport may not have the greatest ground clearance in the world, but its wheel articulation and management of traction were more than ample for the conditions. We'd like to think that some driving skill was involved, too...

Land Rover's newest baby is aiming at a niche that wasn't entirely comfortably occupied by the Freelander: it's more station wagon/crossover than its predecessor's soft-roader sport-utility. For one thing, it feels more carlike on the inside. The trim and finishes chosen for the South African range certainly have a less utilitarian and more premium feel about

them. A vast range of convenience and luxury features are supplied as standard to take on the perceived competition head on. For instance, there's a new 8-inch touchscreen infotainment system, tilt-and-slide row-two seating and up to four 12V power points and six USB charging sockets. On the safety side, the suite of advanced systems includes a first-in-class pedestrian airbag and autonomous emergency braking.

According to Land Rover, both the all-alloy Si4 2-litre petrol engine and the 2-litre turbodiesel feature high-pressure direct injection, low-friction internal components and smart regenerative charging. There's definite potential for good performance and economy.

The Discovery Sport shows that Land Rover is dead serious about making a vehicle with extremely wide appeal in this very competitive market segment. Yet despite having broad appeal, it's sufficiently focused in certain areas – notably off-road – to make it a serious contender that would satisfy those who might previously have settled for a bakkie-based equivalent for tougher conditions. As it's being pitched as a premium vehicle, the Discovery Sport is not cheap, though. With prices ranging from about R540 000 to R730 000, it's up against some premium-brand rivals in a market that's not necessarily about how good your vehicle is off-road.

7 into 5 can go. Squeezing two extra seats into what's essentially a 5-seater footprint involved some clever packaging. The all-new multi-link rear axle is a key to the success of this feature – and to the Discovery Sport's driving dynamics. It's supple and has enough travel to ensure that the marque's fabled off-road ability isn't compromised.





OFF-ROAD CRED

APPROACH ANGLE	25
DEPARTURE ANGLE	31
BREAKOVER ANGLE	21
WADING DEPTH	600 mm



TESLA MODEL S P85D

TESLA GOES TO THE TRACK



The all-electric Tesla Model S P85D became a YouTube star soon after it went on sale last December, showing up at drag strips and spanking muscle cars and exotics alike. I watched those videos and thought, I want to do that. I want to surprise a few guys who think they're about to dust a glorified Prius.

So at the earliest possible opportunity, I procured a P85D and headed for North Carolina's Rockingham Dragway to hunt some Mustangs and Vettes. Activate insane mode! (Yes, to unleash the Tesla's full 516 kilowatts, you push a button labelled Insane Mode.)

The D, as it's colloquially known, is the ultimate Tesla, which means that it's also the ultimate electric production car. Compared with the former Model S performance champ, the rear-wheel-drive P85, the D gains a larger motor at the rear – 351 kilowatts – along with a new 165-kilowatt motor at the front. You lose some luggage space in the front stowage bay, but the benefits are obvious as soon as you floor the accelerator. Electric motors make instant torque, and all-wheel drive provides ultimate traction.

THE D IS THE LATEST EVIDENCE OF HOW TESLA SINGLE-HANDEDLY CHANGED THE ELECTRIC-CAR CONVERSATION.

Combining the two results in off-the-line thrust that borders on disorienting.

I pick up the Tesla at the company's new store in Charlotte, about 130 kilometres from the drag strip. With an EPA-rated range of 408 kilometres, I could probably make it from Charlotte to Rockingham and then home to Southern Pines on a single charge. But I want to check out a Tesla Supercharger station, so I take a detour to a Texas Steakhouse restaurant 175 kilometres away, off I-95 in

Lumberton. In the corner of the parking lot there's a row of high-speed chargers, free for any Tesla with the 85 kilowatt-hour battery.

While I'm inside eating a steak salad, the Model S gains 217 kilometres of range. The Supercharger gives me an extra stash of electrons for the track, but I suppose it would also work pretty well if you're planning a road trip. When I unplug the car to leave, there's a second P85D parked alongside, wearing South Carolina plates.



The Model S can lower its suspension at highway speeds for better aerodynamics. Right: Tesla's plug doesn't fit anybody else's charger, but they provide a variety of adaptors.

Interstate electric-car travel: it's happening.

At the strip I expect to hustle a few suckers who still associate the word Tesla with eighties hair metal. But a few months after its debut, the D is already such a legend that everybody knows exactly what it is. Respect is accorded. In the staging lanes I pull up next to a Trans Am WS6 and ask, "You wanna go?" The driver scopes the Tesla end to end and warily replies, "I guess so." His reluctance is validated by the result. By the eighth-mile mark, the Trans Am is a distant spec in my rearview mirror.

Back in the pits I overhear a guy on his phone saying, "We got a Tesla here! This thing is insane, cuz!" You'd think there might be some resentment towards an optioned-out R1,6-million (in the USA) rich-guy ride showing up at the local Sunday fun runs, but the red Tesla seems to generate nothing but good-natured enthusiasm. I offer the shotgun seat to anyone who asks, including a track worker who introduces himself as Little Terry. "Presumably there's a Big Terry here too?" I ask. "Nope," he replies.

Little Terry and I proceed to dispatch a

2015 Mustang 5.0 in the opposite lane. Which is impressive, since it's plumbed with nitrous, giving it a 75-kilowatt boost. Its driver, a guy named Dan, got a bad launch and that was it. The P85D, you see, never gets a bad launch. Its sixty-foot (around 18 metres) times are consistently around 1,7 seconds, which means that, at that point, the D is doing nearly 80 kilometres per hour. That's bonkers.

The D loses exactly once, when Dan nails his launch and rides the laughing gas to a win. I call it a day soon thereafter, since I've noticed that each quarter-mile run is knocking eight keys off my estimated range. Still, I arrive home with a 150-kay cushion, having covered 352 kilometres and dusted a succession of muscle cars at the strip. The D is the latest evidence of how Tesla single-handedly changed the electric-car conversation. You don't want a P85D solely because of its carbon footprint or your position on Saudi Arabian politics. You want one because it's about the coolest damn thing on the road, a twin-motor sedan – an American one at that – that you can drive all day. The man at the track was right: it's insane, cuz.

FIVE WAYS THE MODEL S DRIVES SO YOU DON'T HAVE TO



GEOCACHING SUSPENSION

The air suspension can remember where you raise it, so that when you arrive at your steep driveway or office-park speed bumps, the car will raise itself.



INTELLIGENT CRUISE CONTROL

If you're on the highway in the right lane and the adaptive cruise control slows you for a car ahead, activating the left turn signal cues the car to return to your set speed. So instead of pulling into the passing lane and waiting for the car to figure out that the road is clear, it starts accelerating as soon as you initiate the lane change.



AUTONOMOUS BRAKES

The regenerative braking is so strong that you can usually drive around without touching the brake pedal. If you actually want to use the brakes and clean the rust off the rotors, Tesla provides a mode to dial back the regen.



BUILT-IN VALET

On a conference call to announce new range-calculation software, Tesla CEO Elon Musk mentioned a somewhat more momentous Model S upgrade that's supposedly coming later this year: the summon function. "As long as you're on private property, you can press 'summon' on your phone and your car will come and find you," Musk said. "And your car will put itself to bed in the garage and close the door behind it."



OVERPROTECTIVE DOORS

If you try to move the car with a door open, it goes about two metres and then slams on the brakes. Keep that in mind if you crack the door open to eyeball your parking space – try to inch the car forward and you'll get brake-checked.

2015 BMW i8

SPLIT PERSONALITY



THE BMW i8 REALLY WANTS TO BE ELECTRIC.

THIS CAR SHOULDN'T HAVE A PETROL ENGINE AT ALL.

I finally got a chance to drive the BMW i8, and it lives up to the hype. Everywhere you go, people do double takes at the outrageous concept car with the BMW badge and the dihedral doors. The i8 is quick, it's sure-footed, and it's even a perversely good deal – it isn't cheap, but it's downright attainable compared with the hybrid hypercars from Ferrari, Porsche and McLaren. But there's one aspect of the car that's at odds with the overall *Mission Impossible* spy vibe: the petrol engine. As a plug-in hybrid, the i8 uses a 96-kilowatt electric motor paired with a 170-kilowatt three-cylinder petrol engine. Building a three-cylinder car that does zero to

THE SPECS

KW:	266
L/100 KM:	City: 8,4, Highway: 8,1
PRICE:	R1 755 000

100 in 4,2 seconds is an achievement, but three cylinders is tantalisingly close to no cylinders. Everything about the i8 – the styling, the carbon-fibre tub, the touchscreen key fob – feels like it was beamed in from the year 2050, leaving the internal combustion unit as an incongruous glance backward. Some people have wondered if BMW might offer the i8 without the battery and electric motor. I'm wondering just the opposite.

BEHOLD, THE TOUCHSCREEN KEY FOB.

For a car as innovative as the i8, not any old key fob will do. That's why BMW is making an optional touchscreen one available. In addition to performing typical key-fob duties, the swipable screen displays information including the car's fuel level, remaining range, and diagnostics. The fob charges in a centre-console docking station and can last three months on one charge.



RENAULT CAPTUR

SPICING THINGS UP

The personal transport market has never been more varied – and that variety is arguably most noticeable in the crossover segment. The thing is, there's only so much you can do with a hatchback or sedan design. But when crafting a crossover, designers can let their imagination run riot. Even if what you come up with is, in the end, based on a common or garden hatchback.

If you detect something familiar about Renault's Captur, that's because it has its origins in the company's Clio. Still, it's a lot more than an embellished version of the popular compact, as are some similar models from other makes.

Renault says the Captur combines the personality of an SUV and the spaciousness of an MPV with the dynamism of a hatch. The striking

exterior with its elevated stance (170 mm ground clearance) hints at the smart touches on the interior. The seating and storage layout is designed along flexible, modular lines – with some typical French quirkiness in styling: for example, the odd shell-shaped seats. But there is a practical side to those seats, which come with removable, washable zip collection covers on some models. The fold-flat rear bench seat slides front-to-rear up to 16 cm, increasing boot space to 455 litres. Other stowage options include a two-position boot floor with hidden storage area. In the two Dynamique models, the boot floor is reversible: smooth on one side with an anti-slide surface on the other. In addition to the practicality there's plenty of convenience and luxury, too – from high-end infotainment that includes sat-nav to a comprehensive suite of driver and safety aids.

Two turbo petrol engine options are on offer. The 66 kW engine is paired with a 5-speed manual transmission and the new-generation 1,2 litre 88 kW EDC with dual-clutch 6-speed automatic. Price: from R219 900

IN DETAIL: CAPTUR 1,2 EDC

MAX POWER	88 kW at 4 900 r/min
MAX TORQUE	190 N.m at 2 000 r/min
TOP SPEED	192 km/h
ECONOMY	5,4 litres/100 km
CO₂	125 g/km



HYUNDAI ix35 1,7 CRDI PREMIUM

AS GOOD AS IT GETS

It's no secret that the ix35 as we know it is at the end of its run. An all-new model will make its debut at the Frankfurt motor show in September and will be available in world markets not long after, possibly reviving the Tucson name in some countries.

Experience has proven that the last run of any particular model is the best to have. With minor facelifts along the way and continuous production improvements, and especially considering the high level of standard equipment on offer, this is as good as it gets before the next model rolls along, inevitably more expensive.

As all-rounders, medium-size SUVs such as the ix35 have proven to be tremendously popular. The Hyundai is one of the top-selling models in this segment for good reason and has proved that it can more than hold its own against opponents such as the Nissan Qashqai, Ford Kuga, Toyota RAV4, Jeep Patriot, Kia Sportage and Mitsubishi ASX, and even more premium contenders such as the VW Tiguan and Audi Q5. It is everything a family car should be – spacious, well-equipped with just about every comfort and convenience item any member of the family could ask for (even in Premium spec it has a reverse camera for tight spots and Bluetooth for your entertainment of choice), powerful (the 1,7-litre diesel is a delight to drive and is guaranteed to surprise with level of performance in town and the open road) and economical (on our extended, loaded runs, returning an average of 6,4 litres/100 km, even bettering Hyundai's own claimed figure of 6,5 litres).

Priced from R369 900 for the 1,7-litre Premium diesel, it makes for a compelling argument viewed against its competitors.



JUST THE FACTS

ENGINE:	1685cm ³ D-CCV 16-valve turbo-diesel
POWER:	85kW/260 N.m
MAX SPEED:	173 km/h
FUEL CONS.:	6,5-litres/100 km
CO₂:	139 g/km
BOOT SIZE:	1 579 litres
FUEL TANK:	58 litres
SERVICE PLAN:	5 year/90 000 km
WARRANTY:	5 year/150 000 km

INFINITI Q50 2.0T THE JUMP OFF

The Mercedes-sourced, 155 kW two-litre four pot hiding under the bonnet is Infiniti's big play to lure more potential owners into the plush leather seats. Although the entry-level Q50 retains much of the tail-happy rear-drive characteristics, you immediately notice the lack of big ol' V6 roar. It's the little things that the Q50 gets wrong: like a just too bumpy ride and boring dashboard styling that just keep it outside of being great value for money. Everything else is there, though, including dual touchscreens, a host of lane-keeping/blindspot/active cruise control driver assistance and 360-degree camera view. But, from the key fob to the indicator stalks, there seem to be a lot of parts from the Nissan bin kicking about here. Mind you, if you stripped out most of the soft-touch surfaces and the leather in the doors to cut R80 000 off the



price, and rebranded this as a Nissan Skyline, these cars would fly out of the showroom. That's a convoluted way of saying that, although the down-specced Q50 fails at being truly premium, the drive is still engaging – apart from the lack of steering feedback due to the drive-by-wire setup – and the car is comfortable enough to keep a small family very happy. **PM**

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Data TRAFFICKING

TomTom (yes, that one) claims to have invented the term Big Data. Here's where they get it, how they use it and how it benefits you.

There's nothing attractive about big data. It's literally just a term to describes a lot of data from various sources and some people get their kicks through crunching that data into something useful. TomTom's annual traffic index illustrates a useful visualisation of big data.

Sourced from a combination of voluntary anonymous user data, media reports and government data, TomTom ranks traffic congestion around the world according to varying criteria. This information not only makes for great filler stories on slow news days, but also shows off TomTom's information-gathering talents.

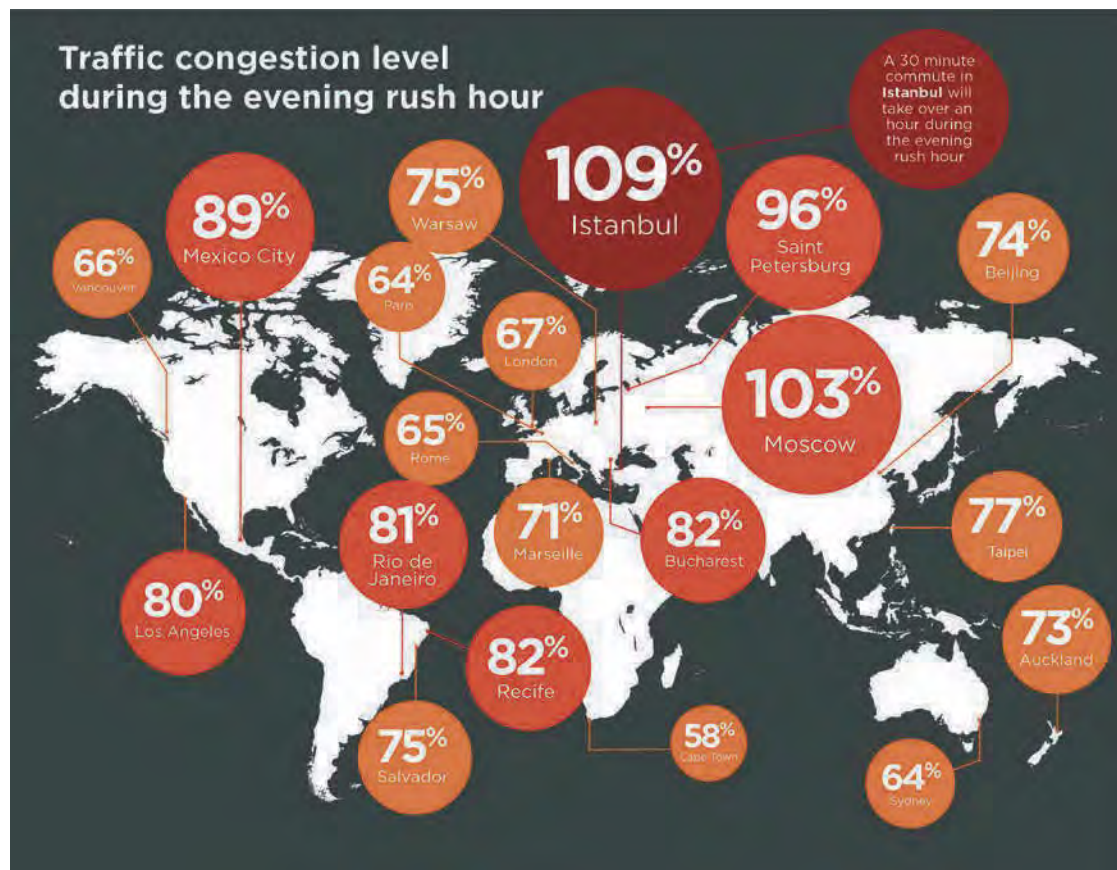
LIVE TRAFFIC

You're running late for work and your usual shortcut is choked up with traffic, as if by magic your GPS unit reroutes you down an empty street, circumnavigating the heaving main routes. How does TomTom do that? How did the GPS know about the defective traffic light when you arrogantly decided to press on with your tried and tested commute? Data.

All the TomTom service user's units feed data back into the system and TomTom gets a clear picture of how fast or slow the individual cars are moving, then matches that new information to the live map and estimates traffic flow along all possible routes. Also you know those cameras in the gantries and those inductive detector loops in the road to help the traffic lights monitor flow? TomTom gets fed that information too through deals with international governments in return for data reports which help authorities make better infrastructure decisions when upgrading or building roads.

Now add in the company's advanced mapping system. When TomTom acquired Tele Atlas in 2008, they bought with it a user feedback model which became the basis for their consumer offering. Users can submit updates and changes to the maps, which is essential a crowdsourced model for live mapping. Then there's the continuous navigation which draws from GPS satellites and data networks (for connected devices) and automatically switches between the two.

It seems a very intricate system to maintain for a company that's main business is becoming obsolete with each new smart-



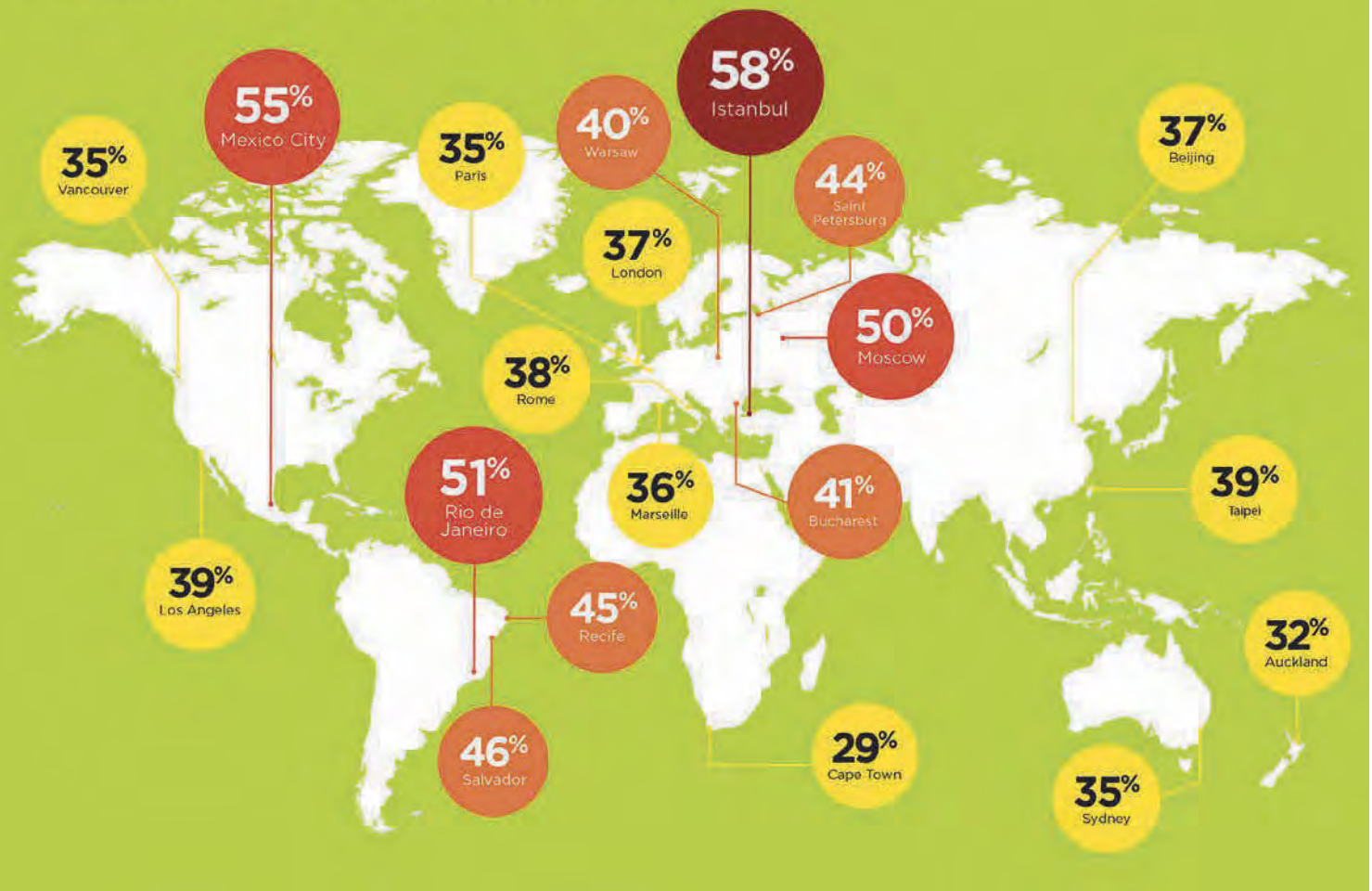
phone sale. But consumer GPS units is not TomTom's main business, it claims to make more money from data management.

It shouldn't come as a surprise that the latest update for Google Maps (21 May 2015) includes live traffic and incident reporting because Google are the kings of big data. Not only can Google draw from all the same sources as TomTom and, to an extent, Garmin, but Google can also scan the internet to pick up on official releases and announcements. If there's planned roadworks in your area and the contractor/local authorities put out a press release on their web site, Google will know about it. But this seamless mapping and navigation only works if the data sources are reliable.

LOCAL HICCUPS

When Duduzane Zuma's Porsche ploughed into a taxi on the evening of 31 January 2014, it opened up a Pandora's box of inaccurate data tracking.

Overall traffic congestion level



TomTom have just launched a cloud service called MyCloud that updates your connected device and syncs across devices in real time, just like Google.

did confirm that the cameras mounted on the gantries are not certified to track speed and thus were useless in the National Prosecuting Agency's (NPA) attempt to establish average speeds for the vehicles, but the phantom trips are worrying. It indicates inaccurate data gathering in the absence of e-tag logging, which would result in highly inaccurate feedback when the data is interpreted.

Another common example of inaccurate data is those popular fitness trackers without any heart rate or GPS sensors. Those work by using, largely, a three-axis accelerometer and an algorithm that interprets the movements in six directions and tries to match the data to predefined values which is translated into a "step" or "distance". If you hold the device in your hand and shake your hand to simulate the required movement, the computer still collects the data as exercise and you'll maybe have a sore wrist.

Data isn't attractive, but it's useful. But also only as useful as the sources. **PM**

To summarise: the incident happened at 10 pm at the M1 South off-ramp, but data states Zuma only passed the closest approaching Tarentaal gantry 43 minutes after the incident and the time stamp for the taxi passing the same gantry was 11.09 pm. The inaccuracies compounded when the gantries registered trips for both vehicles seven hours after the incident when both vehicles were not on the roads.

To their credit, Sanral (South African National Roads Agency)

PINCH YOURSELF

The low-down on the most important mineral that you don't give enough thought to.

By Lindsey Schutters

Salt is vital to your survival, but don't go drinking ocean water, because it won't get you very far. You see, our bodies are majority water and H_2O is bad at conducting the electric impulses that keep our muscles and organs firing. $NaCl$, however, is great at conducting electricity, hence the term "electrolytes". The downside: where salt goes, water follows. So while this is great for pumping up blood volume, your blood vessels are designed to hold only a certain amount of blood and when this volume is exceeded it puts strain on your infrastructure, raising your blood pressure.

As you may know, salt was once traded in equal weight for gold and the Romans paid soldiers in salt. Or what they called "sal" in Latin. Which is also the root word for salary. History lesson over.

South Africa has laws in place to regulate the sodium content in many processed foods (bread, cereal, butter and spreads, savoury snacks, potato chips, cured processed meats and sausages), so you the consumer are left to your own devices when it comes to added salt. Although there's no science to his claim, local salt fundi chef Craig Cormack is wary of the anti-caking agents in salt. If you stick to hand harvested natural salt, you should be fine. Yes that does sound like the new age free-range-organic-craft-handmade trendy stuff, but it was just a matter of time.





SALT PRODUCTION IN SOUTH AFRICA

- Sea salt up on the West Coast uses various pools to evaporate salt.
- Desert salt/pan salt in the north pumps spring water onto the desert floors.
- Evaporation salt (Cerebos) boils sea water until it forms crystals.
- Brine spring salt (Baleni) pumps out over the sand dunes and gets boiled.

LOCK DOWN

Did you know that the Nazis used old salt mines to hide sensitive documents and stolen paintings because the salt in the walls naturally draws moisture away and controls the temperatures? Hollywood adopted the same strategy and stores ancient celluloid film in salt mines. Also, the mines are always expanding, so there'll always be more room.



The essence of life

You wouldn't be alive without these 84 minerals that you'll find in Himalayan crystal salt.

As with all craft industries some questionable facts are thrown around about salt. One of them is that Himalayan rock salt, the ocean and the human body contain the same 84 minerals/elements essential for life.

They are, in alphabetical order:

Actinium, aluminium, antimony, arsenic, astatine, barium, beryllium, bismuth, boron, bromine, cadmium, calcium, carbon, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, erbium, europium, fluorine, francium, gadolinium, gallium, germanium, gold, hafnium, holmium, hydrogen, indium, iodine, iridium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, mercury, molybdenum, neodymium, neptunium, nickel, niobium, nitrogen, osmium, oxygen, palladium, phosphorus, platinum, plutonium, polonium, potassium, praseodymium, protactinium, radium, rhenium, rhodium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulfur, tantalum, tellurium, terbium, thallium, thorium, thulium, tin, titanium, uranium, vanadium, wolfram, yttrium, ytterbium, zinc and zirconium.

When the Bavarian State Office for Health and Food Safety studied Himalayan salt specimens in 2003, however, they found only 10 other minerals accompanying the 95-96 per cent sodium chloride. This isn't to say that you can't classify it as a super food anymore; but rather call it what it is, a condiment.

The downside of Himalayan rock salt is that, much like Tanzanite (the gem that should be worth more than diamonds), you can find it in only one place in the world. This isn't the recipe for a sustainable resource by any stretch of the imagination and, judging by the current appetite for it and subsequent tumbling prices, you can only imagine the appalling circumstances the miners in the Punjab are working under.

A charming byproduct of being a rock salt is that you can get it in big tablets that you can cook on. It's like a naturally occurring plancha that can tolerate temperatures of up to 900 degrees Celsius and will season your food at the same time.



Chef Craig Cormack has an impressive salt collection of over 90 naturally occurring variants; he also receives flavoured artisanal salts from an international network of fans and peers.

BRAIN FOOD

As much as chef Cormack rags on iodated salt, iodine deficiency is a remarkably important health concern. The deficiency accounts for 90 per cent of all goitre cases and is linked to intellectual disability. Goitres caused around 2 700 deaths in 2013 (almost all fatalities were recorded in countries that don't add iodine to their salt) and were once so rife that the fashion world still carries the item of clothing devised to hide them; it's called the choker. If you're not into the commercial salt, you can up your seafood intake to get in enough iodine.

ESSENTIAL SALTS

The four salts you should have in your kitchen

- Maldon salt
- Himalayan rock salt
- Khoisan/Oryx salt
- Baleni salt

Chef Craig also recommends Seepo salt if you're not into spending a small fortune on seasoning.





Visit Chef Craig Cormack's restaurant, The Goose Roasters at the Woodmill in Stellenbosch or book a salt and wine pairing at Fleur du Cap.

PopMech salted caramel popcorn ice cream, dry ice and popcorn tuille

INGREDIENTS

Dry ice
Water
1/3 of a standard bag popcorn
100 g sugar

ICE CREAM

500 ml cream
500 ml milk
200 g sugar
12 egg yolks

1. Whisk the egg yolk and sugar into ribbon stage, then add it into the milk and cream mix. Once ready to add in the ice cream machine, add popcorn and caramelised sugar and churn, when ready to remove place in a freezer until needed.
2. Caramelize the sugar in a pan. When it turns golden, remove from the heat add the popcorn that hasn't popped and season with coarse salt. Make the tuille by smearing some of the caramelised sugar on greased wax paper and place some of the popcorn on.
3. In a bowl place the dry ice; then, in a glass bowl, scoop the ice cream, garnish with a tuille. Finally, add the water to the dry ice, for the effect.



HOW MUCH IS ENOUGH?

The Institute of Medicine's findings, released in the 2013 report *Sodium Intake in Populations: Assessment of Evidence*, suggest no benefit for anyone to aim for sodium levels less than 2 300 milligrams a day. **PM**



LEARNING

TO FLY

2

THE **STALL**

An acclaimed novelist takes the controls of an aircraft for the first time.
And he's scared to death.

BY JOSHUA FERRIS

WE HAVE SQUARED UP TO THE DOUBLE UNBROKEN YELLOW LINES

that separate the taxiway from runway 28 at Caldwell Airport in Fairfield, New Jersey. It is my second flight lesson inside Six-Two Romeo. My instructor is Tom Fischer: shaved head, tinted specs, a fresh company Polo every day. Between lessons, Tom puts out fires set by regulators, mechanics, staff instructors, student pilots, calls of Nature, and the demands of lunch. And that's just what I know about. Circling his head, who knows: forecasts, fuel costs, dreams of franchises. On the ground he can seem beleaguered. He can seem harried and curt. But put him inside a plane and the man transforms into an angel of patience and calm.

We have run through the pre-takeoff checklist, which includes making sure the flight controls are free of any last-minute obstructions and that the engine doesn't peter out suddenly when throttling down. It's prudent, when taking off, to have working controls and a running engine. Before radioing to the tower to request clearance, Tom informs me that today I will be doing everything on my own to get us up into the air.

My first lesson was easy. I was so unsure of everything, so frightened and awed, that going up wasn't half as bad as all that dreadful anticipation. I'd even say it was fun. But then, Tom did almost everything: takeoff, landing, a lot of the pilotage. I turned the yoke to the left, I turned it to the right. Wheee! I learnt where the throttle was located. "Is this the throttle?" I kept asking Tom, pointing. "Which way does it go again?"

When Tom tells me that I alone am in charge of getting us up into the air, I have to ask myself: which one is the throttle again? Which way does it turn?

A word about your pilot: when it comes to the physical world, I've always considered myself at something of a loss. I'm talking about switches and levers, valves, winches, latches and locks, hasps, handles, knobs, and hinges. If it needs to be pushed, I pull it. If it turns clockwise, I try to yank it out. I poke instead of flip and jimmy when I should toggle.

The instrument panel on Six-Two Romeo, less involved than those you spy on your way back to Economy, nevertheless bristles with knobs and switches. Now, it's one thing for me to confuse the volume knob for the input knob on a stereo receiver; it's

another thing to get confused inside Six-Two Romeo, where every mistake is potentially fatal. Not really, or not likely, because Tom is in the plane with me. But my irrational fear isn't contained by the knowledge that Tom is in the plane. Irrational fear whistles like the wind at the windows. It kicks the stomach into gear like so much turbulence. It drowns out every word of Tom's helpful instruction.

Tom reviews how the throttle works. Then he reminds me to engage the right rudder pedal as we go down the runway. The right rudder offsets the airplane's natural tendency to yaw to the left, a consequence of the propeller's asymmetrical thrust. But, overcome as I am by the anxiety of getting us up into the air alone, as we take off I forget which one I should be using. The left? The right? I decide that it must be the left. I punch the throttle in and off we go – not trending but hurtling to the left like a clown car under a big top.

Tom wrestles the plane under control. As it happens, we are forced to abort takeoff anyway when a groundhog pops out of its hole and scurries across the runway.



became obsessed during my time in the plane with the question of initiative. How did I reach out and wilfully take control of an airplane I didn't yet know how to fly? I didn't want to make a mistake.

Up there, mistakes seemed like a matter of life and death. Let Tom reach for the controls, I thought. He's the expert. But then, how would I ever learn?

I'd been flying for about a month when, after a lesson of one deplorable landing after another, Tom prescribed two hours in the simulator. I was making too many involuntary mistakes very near

the ground: coming in too fast, rolling the plane at the last minute, yanking up on the yoke and causing the runway to disappear beneath us. "You can't land on a runway you can't see," Tom sensibly suggested. He wanted me out of the plane and in a controlled

Joshua Ferris is the author of three novels, including *Then We Came to the End*, a finalist for the National Book Award, and *To Rise Again at a Decent Hour*, nominated for the prestigious Man Booker Prize in the first year American writers were eligible to receive it.



LEARNING

TO FLY

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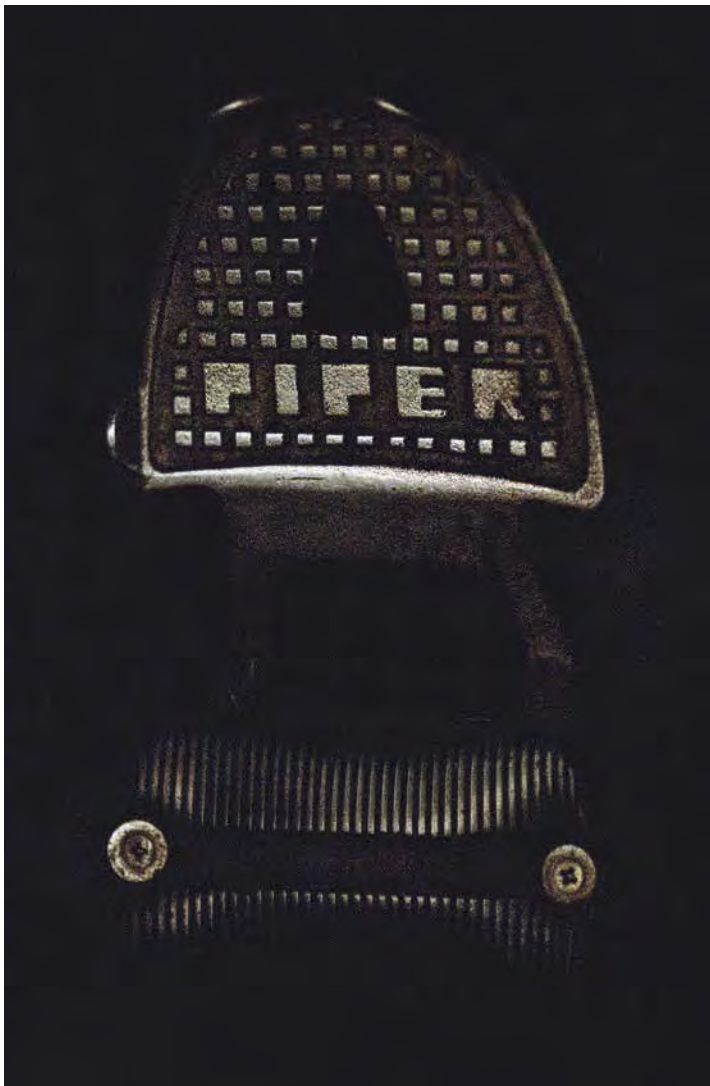
environment where we could pause the action at the moment I made a mistake and zero in on its causes.

The dubious advantage to simulated flight is emptying the cockpit of everyone but yourself, so that you see just how spectacularly you would crash without your flight instructor beside you. It's oddly as nerve-racking as the real thing. I consistently came in far short of the runway. One landing in particular, I found myself wildly, dramatically short – so short I was on course to crash long before the runway began.

"Tom," I said. "I seem to be short of the runway."

I acknowledged the problem all right, but I did nothing to correct it. I did not raise the nose.

'WHAT INTERESTS ME, IS WHY YOU WOULD SAY THAT AND NOT DO ANYTHING ABOUT IT'



I did not increase the power. I might have throttled all the way up and re-entered the air, but that possibility didn't even occur to me. I just keep sinking until I hit the Earth, which I did very, very hard. I looked back at Tom, who was sitting behind me at the computer.

"What interests me," he remarked dryly, "is why you would say that and not do anything about it."

That was the mystery! I just couldn't spur my will into action. What is the will? I tend to think of it as a secret power, something that erupts from me but remains independent of me. I do not will my will – it just is. It just does. But it can't do what it does not know how to do. It holds back, remains absent, is in some way in negotiation with my intelligence. They have a back-and-forth. Will: Master all the instruments and the control panel and I will fall in line. Intelligence: But how am I going to master anything when you refuse to engage? Will: I'm saving our life by not engaging, pal. Intelligence: But you're also preventing me from learning. Will: I'm preventing you from making stupid mistakes, you idiot! Intelligence: If you won't engage and I can't learn, how will we ever do a solo flight? Will: A solo flight? As in, a flight without Tom? Intelligence: That's the goal here! Will: Good luck getting me into the plane on that day.

Worried as I was that a mistake might be fatal, positive action in Six-Two Romeo would have implied that I was, in some way, okay with dying, that I had accepted the possibility. I wanted to fly, sure, but I didn't want to die.

T

om Fischer says that the closest anyone comes to dying during a flight lesson is on the drive to the airport. In my case, it's true: I zoom through the city and over the bridge on roads with lunar potholes and dips made for motocross. I sandwich myself between two semis on I-80 as I drift upwards of 150 kilometres per

hour. The steering wheel is a thing of familiarity and common sense, and I can brake on a dime without thinking.

If my sense of safety and control in a rental car is an illusion, it's a useful one, allowing forward motion. The conditions are reversed inside Six-Two Romeo. I'm surrounded by peril, I feel, and though the yoke is in hand and the throttle within reach, the illusion is one of paralysis. Lacking perfect know-how, I lack agency. I can't take the initiative.

Part of my inaction is due to irrational fear, and part of it is due to the many technical things I have yet to learn. I have to learn how to use the controls: the yoke, the ailerons, the rudder pedals, the throttle, the trim tab, the flaps. I have to learn how to pilot: how to climb, how to descend, how to hold a steady course. I have to learn how to use the instrument panel and how the readings work in tandem with the controls. I quickly learn that, in a medium as marvellous as air, there is no such thing as an independent change. A simple bank to the left might require a change in pitch. It might require a change in rudder. It might initiate a change in airspeed. It will almost certainly change my heading. Once I commit to memory all of these interrelated changes and learn how to anticipate, accommodate, and modify them according to my piloting goal, I have to fold in the complications of wind and weather. Once I get a handle on weather, I have to learn how to navigate over unfamiliar terrain. Once I learn how to navigate, I have to learn how to communicate with air traffic control. More daunting than any of this, I have to learn how to land.

My second lesson was more or less an introduction to all this. For my third lesson, I'm no more prepared for what Tom suggests than I was for getting us up into the air on my own.

"What manoeuvres have you been reading about that you'd like to try out?" he asks on our walk out to the apron where Six-Two Romeo is parked.

I wouldn't mind the manoeuvre with the hot towels. Or the manoeuvre with the warm mixed nuts. Or the manoeuvre where I roll over and sleep until we're an hour outside of Shanghai.

"How about stalls?" he asks. "Should we do some stalls?"

Now, I have read about stalls, online and in books. I'm aware that they exist. The word "stall" captures the attention like little else. It evokes breakdown, arrested midair motion, an immediate and irrecoverable fall from the sky. Stall the plane by some terrible piece of luck, according to my magical thinking, and you do not live.

"You can stall the airplane?"

"Of course you can."

"And then what?"

"Then you recover," he says.

"You can recover from a stall?"

"I certainly hope so."

"And you stall the plane while inside it?"

Tom appraises me with silence and something on the borderline between confusion and derision.

"Where else would you be?" he asks.

I suspect that Tom has a hard time understanding the fear I take up into the air with me. He comes from a family of pilots and has been flying from a young age. He commands Six-Two Romeo the way John Wayne once rode a horse. And he goes up many times a day with student pilots of wildly varying proficiency, overriding all their mistakes. He has lost touch with what's scary about flying, if indeed he ever knew that fear to begin with. If he can tap into my fear, it's a purely intellectual exercise. Which is as it should be; if he shared it, we would be two quivering ninnies hurtling to our deaths in no time at all. His confidence that we have nothing to be scared of is the only reason I ever stepped foot in Six-Two Romeo. He takes my fear as a matter of faith and I take his confidence as a matter of faith, and between us, we have almost nothing in common.

We also have little in the way of a shared language. Three-dimensional flight is conceptually challenging; grasping those concepts, envisaging them, gaining a feel for them through words alone, is next to impossible. "Guard the yoke... stretch out the power... pitch for airspeed, not the runway... turn longer, not steeper... okay, now hold it off, hold it off, you can't force a plane to land..." I don't understand a thing.

We do clearing turns over the onion fields. Then Tom says to me, "Okay, let's take some power out."

This is all so new to me, and I have been so chronically afraid of flying for so long that I'm possessed by magical thinking inside Six-Two Romeo. If I shift in my seat, I believe I will throw the plane off balance. If I press down too hard on the rudder pedals, my feet will plunge through the floor panel. If I let go of the yoke, the plane will nose down like a dart and explode in the onion fields. I can't overcome my amateur conviction that every control input or change in attitude has no margin of error and is quickly irreversible, unmanageable, and doomed.

What Tom doesn't know is that I have deliberately refrained from shifting in my seat to magically prevent bad things – like the power going out – from happening. I have coaxed from the airplane, by the assiduous application of my ass, its promise that it will not lose power. Why would we willfully undo all of my hard work?

"Go ahead," he says.

I reach for the throttle and pull it back. The engine's roar falls to a purr, and we are suddenly floating in comparative silence. Seconds pass. I have nearly lifted my entire body off the seat in order to keep us aloft. If there were ever a moment when the plane should fall from the sky, this would be it.

But we don't fall.

We shed speed: eighty knots, seventy, sixty. We keep the nose



pointed up to maintain our altitude, which kills our speed even further. I expect a plummet, a midair breakup.

We get only slower flight.

"Okay, now put the power back in."

I return the throttle to full power and the engine resumes its roar. I have been labouring under the illusion that something so dramatic as a reduction in power to the engine is irreversible – but I take the power out and I put the power back in, and the engine just goes along with the show.

"Now we pitch up, as we do when lifting off the runway."

I do nothing.

"Go ahead," he says. "Pull back on the yoke."

"Pull back on it? Are you sure?"

"I'm sure," he says.

"How far?"

"Fifteen degrees."

Fifteen degrees makes for a dramatic climb. We seem to be pointed at the sky like a rocket. We are taking off again from runway 28 at Caldwell – only this time at 2 500 feet in the air.



LEARNING

TO FLY

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This is the purpose of the power-on stall manoeuvre: by mimicking what might go wrong on takeoff, we familiarise ourselves with those conditions so that, should they arise at that critical time, we stand a chance of correcting them. But during practice we do so with the luxury of altitude. The windscreen fills with the white of God, and my eyesight, which guides me through most things in life, becomes secondary. A climb like this is almost entirely about the body. We seem to be inside some kind of compression chamber or intergalactic pod where there is simultaneously sensory deprivation and the introduction of an overwhelming stimulus, a vibration evolving towards a shudder, as in a washing machine with an unbalanced load. It is the opposite of that gentle float we were in just seconds ago, when things were benign and fluffy. It is everything, in other words, that I've been taught to expect from movies and nightmares of an airplane about to crash.

But we don't crash.

"Okay, now pop it," says Tom.

He wants me to pull back on the yoke all the way, to kill what remains of our lift. I do and we stall. Until now, I would have believed recovery impossible from such dramatic behaviour – arresting an airplane in midair! – and that we would plummet to our deaths. And we do plummet, a little, as I push the yoke forward at Tom's instruction. We glimpse the green earth of New Jersey in the windscreen. By descending, we regain speed. I pull back on the yoke, arrest our fall, and level off. We enter a positive climb and reclaim our lost altitude.

I experience all of this with the most wide-eyed wonder. More wondrous still is my active participation. I'm struck dumb by my contribution to this seemingly reckless, perfectly natural in-air performance. The plane has acted in keeping with the laws of physics and the laws of mechanics and the laws of flight schools everywhere. An airplane is not, it seems, a magical thing with occult intent. It is a dumb and analogue machine that does what the wind and I ask of it.

F

ear continued to get me throughout my flight training. I made big mistakes because of it. I had a bad habit of choking the stick, as if the tighter I held it, the safer I would be. But it was the opposite that holds true. The stick, or yoke, is a subtle and sensitive instrument; by throttling it in a death grip, I foreclosed all

delicate input changes, continually threw off my airspeed, prompted many unwanted rolls, and turned into a loose cannon whenever we tried to land – everything I hoped to avoid by choking the stick! "Stop pinching the yoke," Tom told me I don't know how many times. "How would you like to be pinched?" Sometimes I think that the story of how I learnt to fly resolves entirely into the story of how I learnt to take hold of the yoke less like a chicken's neck and more like a sweetheart's hand. I couldn't do that until I rid myself of fear.

Between my ninth and tenth flying lessons, the fever broke. I don't know how or why. Part of it was simply accumulating time in the air. After ten or so hours, I no longer had any reason to think the plane crashed by magic. And part of it was a better technical grasp of the many aspects of flying. I gained confidence in my power to make the airplane predictable. That is the pilot's pre-eminent goal.

But another part of it was a growing fatigue,

even a disgust: I was sick of being scared. I was tired of not taking the initiative.

I wanted to fly. I wanted to have fun.

Before my first lesson, I asked Tom if I was going to die. Tom is a circumspect man, careful to choose his words, but never at the expense of a forthright answer.

"Eventually, yes," he said. "Nobody gets out alive."

Later, he added, "Now, are you going to live? That's another story. That's a subjective question. Not dying is not the same as living."

One day, Tom and I went up with barely a word exchanged between us. We climbed out of Caldwell and over the golf course, its tiny sand traps amoeba-like at that distance. I turned over I-80, still climbing, and turned again to the downwind. I arrested the climb at pattern altitude and called back the power from the red line. At midfield I radioed the tower for permission to do a touch-and-go on runway 28. I reduced power and began a positive descent before I turned base to final. The runway came into view and I reminded myself to go easy on the yoke. We passed over the little fence that divides the highway from the airport. I kept a steady sight picture of the numbers on the runway so as not to come up short as I had on the simulator. I came in not too fast, not too slow, not too high, not too low. I rode the flare, holding off on touching down, and at the moment of truth, slowly set the wheels on the ground. Once the nosegear kissed the runway I immediately powered up again, climbing out once more over the golf course into a fine bright winter's day.

At the outset of my flight instruction, I did not think it possible to take the plane in hand from start to finish. Where had the will to do so come from? I didn't know. Somehow, the will can be nurtured. Somehow it can be flexed, like a muscle, and strengthened. What a mystery! A mystery on the order of the soul.

A half a dozen touch-and-goes later, we ended the lesson, and I taxied Six-Two Romeo back to the apron. "I don't know if you know this or not," said Tom just before we stepped out of the plane,

"but I didn't touch the controls a single time today." I had done everything, from first takeoff to final landing, without a single input or correction from my flight instructor.

Yes, the risk of flying in an airplane is dying in an airplane. But if I kept flying under the influence of fear, I would never have learnt to fly. I would have kept Tom next to me at all times, deferring to him, living through him. God knows I wanted to avoid dying at all costs, but not if it meant not living. Nothing I learnt when learning to fly was quite as important as that. **PM**



LEARNING

TO FLY

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Part 5 of our 10-part series Motorsport Technology Down the Ages

Riding the *wind*

Two conflicting requirements lie at the heart of why a Grand Prix car looks the way it does.

1. It needs to go as fast as possible on the straights.

2. It needs to go as fast as possible around corners.

For 1, the car needs to slip through the air with the minimum of drag. For 2, it needs as much downforce as can be created... which means drag. Speed-sapping drag.

You can make the cars more slippery and gain a few seconds in lap times. The problem is, you'd lose so much in cornering ability that it would be pointless.

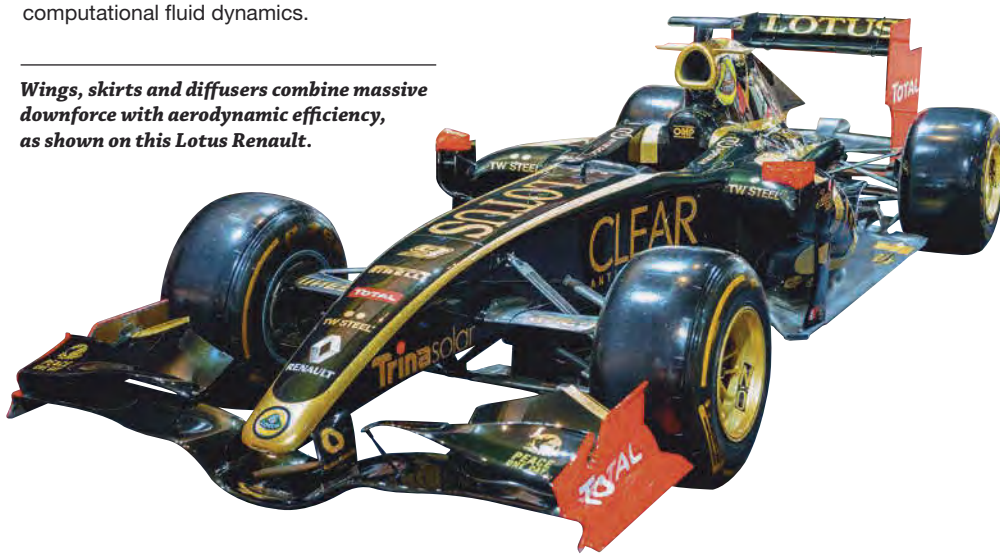
How much drag is too much? Road-car designers feel pretty satisfied when they have managed to create a vehicle that seats five, is efficient, yet doesn't look like a toothpaste tube on wheels. In the battle to maintain a balance between low-drag design and practicality, they'll settle for a drag coefficient under 0,3.

Top single-seater racers are more likely to be up around 0,7, even as high as 1,0. That's the result of designing for downforce of several times the car's weight. The crushing force helps maintain grip while cornering. It provides sufficient downward pressure to act as an air brake when the driver lifts off the accelerator pedal. At a high enough speed, it would theoretically allow the car to be driven upside down.

And there are other things to get to grips with: the car's aerodynamics don't affect just its handling and grip. Engine and brake cooling depend on airflow being channelled in the right direction. Designers also have to ensure that the driver remains safe in a crash.

Today, under strict limitations on real-life testing, the tools of the trade are wind tunnels and, lately, mathematical modelling, prototyping and computational fluid dynamics.

Wings, skirts and diffusers combine massive downforce with aerodynamic efficiency, as shown on this Lotus Renault.



But early aerodynamic design came straight out of the "if it looks good, it is good" school. It didn't always work.

The explosion in aero design started in the 1960s – the era of the wing. If a wing made an aeroplane go up, why not invert it to keep a car more firmly down?

As the science became more sophisticated, the entire car became thought of as part of an aerodynamic system that even includes the shape of the driver's helmet. These systems can be – *must* be – tailored to specific conditions or racing circuits.

Jim Hall's "ground effect" Chaparral provided the breakthrough. Acknowledging that the ground formed part of the airflow system, ground effect bodywork used shaped undersides, skirts and even fans to create a low-pressure zone underneath that sucked the car to the tar – with less drag than the conventional body-plus-wing design. By the 1970s the revolutionary Lotus 78 and 79 were essentially road going wings. Ground effect was essentially banned in F1, but endures in IndyCar.

Designers are always looking to push the boundaries, with now-illegal solutions that ranged from bodywork that flexed at certain speeds to aerofoil-profile suspension members and Gordon Murray's Brabham BT46B, which used what amounted to a vacuum cleaner to create a downwards suction force. And yet... bodywork on newer-generation F1 designs is able to generate vortices under the car that, legally, create the ground effect. And DRS (drag reduction system) allows drivers to adjust the rear wing on the fly to lower drag briefly for higher top end speed, say for overtaking. There's nothing new under the Sun...

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HOW TO GET STARTED IN...

BY PHILIP PANTUSO

WELDING

Whether you want to restore a car or just make your own postbox, with the right tools and a little bit of patience, welding is surprisingly easy to pick up.



Choose your method

► **THERE ISN'T ONE** welding process suitable for all applications, so you need to consider these factors: the type and thickness of the metal you're welding, how big the job is, whether you're welding indoors or outdoors, what you want the welds to look like and your budget. The most widely used form of welding today is electric arc welding, in which an electric arc melts an electrode (welding wire, for instance) and partially melts the base metal. When the molten metals cool, the parts fuse together. There are different types of arc welding, but we're going to concentrate on MIG (metal inert gas). A form of wire-feed welding, it's the easiest type to master, especially if you're teaching yourself.

→ GLOSSARY

Base: The metal on which you lay down the weld.

Bead: The molten metal after it solidifies.

Electrode: Conducts current to create the electric arc. Electrodes

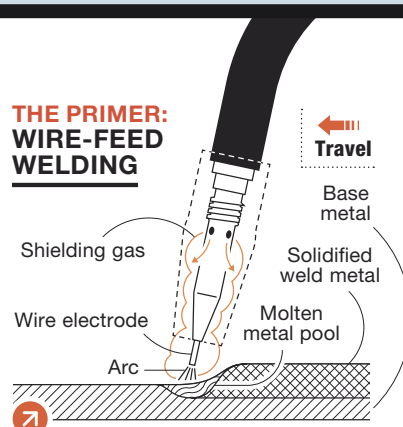
can be either consumable (MIG, FCAW and stick welding) or non-consumable (TIG), which describes whether or not the electrode melts during the welding process.

Flux: In stick and flux-cored welding, flux is the material that shields the weld puddle from oxygen and airborne contaminants. This protective layer improves

the bond the filler metal makes to the base metal. A weld free of contaminants is also stronger and is often more aesthetically pleasing.

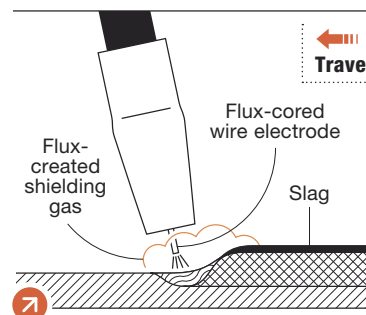
HAZ: Heat-affected zone, the area of the base metal that is not melted, but nevertheless has its metallurgical properties altered by the welding process.

THE PRIMER: WIRE-FEED WELDING



METAL INERT GAS (MIG)

Uses a weld gun that continuously feeds wire from a spool when the operator presses the trigger. Along with the wire, the weld gun simultaneously supplies a shielding gas that protects the metal from impurities in the air. MIG yields cleaner, better looking welds than stick welding.



FLUX-CORED ARC WELDING (FCAW)

Similar to MIG, except there's no separate shielding gas because the wire electrode has flux in its core, which creates its own shield as the wire melts. This windproof set-up makes FCAW a good method for welding outdoors.

PHOTOGRAPH BY THOMAS PRIOR

Buy your equipment

You can buy a quality set-up without emptying your bank account.



► WELDER

The welder is your biggest expense, so don't cheat yourself; a cheap welder will only frustrate you and make learning more difficult. A wire-feed welder uses ordinary household current to produce an extremely hot, high-energy electric arc. Inside the machine is a small motor-driven spool of welding wire (the electrode). The wire is fed down a hose to a trigger-activated welding gun. When the operator touches the wire against the base metal, the arc melts the wire and partially melts the base. In MIG welding, as long as the trigger is down, the gun keeps feeding wire and gas.

The **Lincoln Electric Power MIG 210** is new technology for a great price: It allows an ambitious beginner to MIG-, TIG-, and stick-weld.

The **Millermatic 141** is a good introductory option. It's a wire-feed welder that can be used to weld thin aluminium and steel between 0,6 mm and 5 mm.



TIP!

Your welder also has a work lead coming out of it. This is an electrical cable with a clamp on the end that attaches to the base metal and completes the electrical circuit required to weld. If dirt, rust, or paint interferes with the lead's contact, your weld quality will suffer.



The **Antra AH6-660-0000 Solar Power Auto Darkening Welding Helmet** provides lots of price options, depending on lens size.

► WHY YOU WANT AN AUTO-DARKENING HELMET

The light generated by any arc-welding process is incredibly bright, and it will burn your eyes if you're not wearing a helmet. For years, traditional welding helmets had a permanently darkened viewing shade, but that meant you had to flip your mask up whenever you weren't welding. New auto-darkening helmets protect against harmful light emissions by automatically darkening their clear lens to a preselected shade in milliseconds, using LCD technology in their glass. Each helmet also has controls to personalise settings.

► WELDING WIRE

Wire is relatively inexpensive. A simple rule of thumb is to use a thin welding wire on thin sheet material, and increase the wire diameter as the material's thickness increases. A welder takes at least two different diameters of wire. The owner's manual for the machine tells you what it takes, and there usually are instructions on the flip-up panel on the side of the machine. It's all surprisingly intuitive.

► GAS

Buying the right shielding gas is important, so make sure you know what type of job you plan on tackling. You can pick up a reusable tank of gas from your local welding supplier. The pressure will vary depending on the type of torch you're using and how deep you want your welds, but generally you'll stick to between ,7 and 1,2 kPa. As for the gas mixture, a home hobbyist with a wire-feed welder can usually get by with 100 per cent CO₂ shielding gas. For a cleaner weld, use 75 per cent CO₂ and 25 per cent argon.

► OTHER TOOLS

Welding cart: wire-feed welders can weigh up to 35 kilograms, so build or invest in a welding cart to increase portability.

Awl or carbide scribe: to mark cut lines.

Right-angle grinder: for grinding, bevelling and flattening welds, as well as for surface preparation.

Mitre clamp or magnet square: to secure joints.

Chipping hammer and wire brush: for cleaning up slag and spatter.

Welding pliers: to trim welding wire and remove spatter from the welding-gun nozzle.

Different metals have differing levels of thermal diffusivity, depending on how well the metal conducts electricity.

Pool, or puddle: The molten metal, before

it solidifies.

Shielding gas: Inert or semi-inert gases that protect the weld area from oxidation and impurities in the air. Argon, helium and CO₂ are the three most

common shielding gases used in MIG welding. When selecting your gas, the base material, weld properties, and clean-up all must be taken into account.

Slag: When the flux melts it emits a gas that solidifies into a protective coating called slag, which is removed during grinding.

Prepping your weld

3

Laying down the bead is only a small part of the process.

► Ready the metals

Use a wire brush and acetone to remove oils and dirt. If you need to cut the metal, mark a line with your awl or carbide scribe, and cut along it with a metal-cutting chop saw, a hacksaw, or a grinder with a cutoff wheel.

► Grind the edges

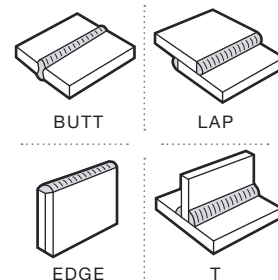
But only the ones you plan to join, and use a right-angle grinder. This is called chamfering. A chamfer is a bevel between the adjoining edges of two pieces of material, typically at 45 degrees. This creates a

space for the filler and provides greater structural integrity to your weld. Doing this for butt joints, especially, is a good idea.

► Position the metals

With your mitre clamp or magnet square, secure the joints to keep the pieces of metal in the same plane before you begin the weld.

[KNOW YOUR JOINTS]



TIP!

You are dealing with sparks, fire and molten metal, so don't start welding before putting on a welding jacket or apron, leather gloves and a helmet. If you want to save money, a good-quality long-sleeve cotton work shirt can stand in for a welding jacket. Don't forget your work boots (no sneakers) and remove jewellery from your wrists and neck. When grinding, put on safety glasses and a full-face shield. Keep an ABC fire extinguisher nearby, too.

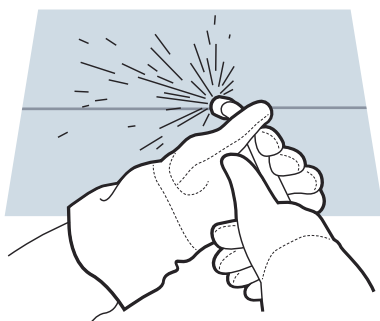
4

Laying your weld

Finally it's time to melt some metal.

► Body and hand position

Think of the welding motion like a golf swing – you want as few moving parts as possible, and you want the motion to be fluid and repeatable. When possible, hold the welding gun with two hands, or use the wrist of your off hand to guide the hand holding the welder (think of a billiards shot). With the welder off, do a dry run to make sure your positioning is good. The steadier your hands, the better the weld.



► Tack welding

Before starting, check your gun. The wire electrode should stick out between 5 and 10 mm. Make sure the nozzle is clear of spatter and that the wire tip is clean. Then make a few tack welds, just enough to connect the base metals, along the joint.



A good line of welds should look like A STACK OF SPLAYED COINS.

– STEPHEN SOMPLE, EMPIRE METAL FINISHING

► The final bead

After you've tacked the metals into place, you can lay down your final weld beads. Keeping the weld gun at about a 75-degree angle to the base, move slowly from left to right (if you're right-handed), spending one to two seconds laying down each bead and maintaining a constant arc length. Don't concentrate on the bright arc. Look at the edge of the weld puddle, and when you reach the end of your weld, pull the electrode back from the metal and allow it to cool.

5



Grinding your weld

If you don't care how your weld looks, or if it's on a piece of metal that won't be visible when your project is completed, you can skip this step, because you are done. Congratulations – you've made your first welds. Work on perfecting your technique on scrap metal. Welding is a lot like playing the guitar: it's not hard to do it a little bit, but to become proficient you need practice, practice, practice.

► Flush-grinding welds

For a smooth finish, use a 36-grit grinding wheel attached to your right-angle grinder to grind along the weld path, not across it, for uniformity. Go slowly. If you grind through your weld, you'll have to start over. When grinding, you should see only orange sparks. Blue means you're pushing too hard. Once you've finished, grab a zirconia flap disc for precision shaping and finishing

PM

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1 GSB 18V-Li IMPACT DRILL - INCLUDING CHARGER AND 3 BATTERIES R2450 (537547)

STEP 2: CHOOSE ADDITIONAL BARE TOOLS *EXCLUDING CHARGER AND BATTERIES

2 GST 18V-Li JIG SAW R2250 (482404)

3 GKS 18V-Li CIRCULAR SAW R2250 (482407)

4 GDS 18V-Li IMPACT WRENCH R2250 (482409)

5 GWS 18V-Li ANGLE GRINDER R2250 (482408)

6 GBH 18V-Li COMPACT ROTARY HAMMER R2250 (482410)

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COMPILED BY THE EDITORS > popularmechanics@ramsaymedia.co.za

PM TESTED



WARM AND DRY

You'll be saving on your laundry bill after you read this

BY LINDSEY SCHUTTERS

MY WIFE DIDN'T ENJOY THIS TEST as much as I did, but that says more about her preconceived ideas brought on by my usual technical clothing than my revelling in wearing the same shirt for a week. Base layers are hard to master because they touch the skin, so they must be comfortable and remove moisture quickly. All the shirts on this page do that and a whole lot more.

THE TEST:

All the garments were worn for the most active parts of five consecutive work days and evaluated for odour, comfort and original shape. All were exposed to at least four 8 km round trip bicycle commutes and a minimum of two CrossFit workouts of an hour each. Each evening they were hung out on a clothes horse near to a partially opened window.



REEBOK ONE SERIES HOODIE

The only 100 per cent synthetic shirt on test put in a heroic effort. Used primarily over a merino shirt on commute and before (including warmup) and after a workout to soak up all the moisture coming off of the wool, it rode solo on the final two days of the test cycle and held its own. There was some noticeable bad scent on day four and I couldn't bring myself to wear it in the car home on day five, but the Play Dry polyester exceeded my expectations.



CORE MERINO T-SHIRT

Our local merino products can definitely hang with the kiwis in terms of fine yarn and style. The Core shirt performed up to the Ice Breaker standard, but did start to smell a little by the Friday. Although I suspect that was partially due to me shoving it inside a plastic bag directly after a particularly taxing workout – I had a flight to catch. Go one size bigger if you're gonna order from them to avoid the overstuffed-condom shtick that I was channelling.

PHOTOGRAPHY BY KIAN ERIKSEN

ADIDAS TERREX STOCKHORN HOODIE

Yes this is a mid layer, but Adidas are only rolling out base layers in 2016. The star of the show is by far the 37.5 moisture, odour and heat management technology. I've gone for a run in fleece before and I could never wear it again, with this one I went three days before smelling my efforts. It moves well with your body, and keeps you cool and warm. Good effort.



ICE BREAKER MERINO T-SHIRT

After you put your first merino wool shirt through its paces, you'll wonder why everything isn't made out of merino. It keeps you warm when it's chilly. Keeps you cool when it's warm. And moisture wicking gets no better. Ice Breaker is the gold standard that all technical fibres must try to emulate. Two weeks of daily cycle commutes, intense CrossFit sessions and even two 5 km runs and I detected only a hint of armpit stench. Original shape was well maintained and a tomato sauce stain even miraculously disappeared after a day.

LAST LAUGH

One thing that survived the entire testing process without ever seeing a basin was this trusty Buff. Made from recycled plastic, the multifunctional headwear dried sweat from my brow, kept my neck warm on early morning rides and acted as an emergency towel when changing into presentable clothes at work. Smells like the day I bought it. **PM**



SKILLS

Bowers & Wilkins CM Series Speakers, from R12 000

A good frequency response (which frequencies the speaker can play) for a centre speaker is 70 to 22 000 hertz. An ideal sensitivity (how loud it can play on one watt) is about 87 decibels. The Centre S2 (shown) can go from 70 to 28 000 hertz with a sensitivity of 87 decibels.

Marantz UD5007 Universal Disc Player, R11 000

A high-end record player and pristine records will give you great sound, but according to our expert, audio-video consultant Mike Olson, CDs are more reliable. And if you want to watch movies, a disc player is an integral part of the set-up.

THE AUDIOPHILE'S GUIDE TO HIGH-FIDELITY SOUND

In 2015, music is maximally portable. You can take the same playlist to the gym, the beach, your car, and your office. But your house is still your kingdom. Here's how to make whatever you listen to sound best where it counts. BY MATT GOULET

Sonos Connect, R7 800

Wirelessly integrates anything on your computer or mobile device, as well as preloaded radio stations and online services, into your sound system. It can broadcast lossless files (which don't delete information during the compression process) to multiple rooms, and can even send sound wirelessly to some speakers.

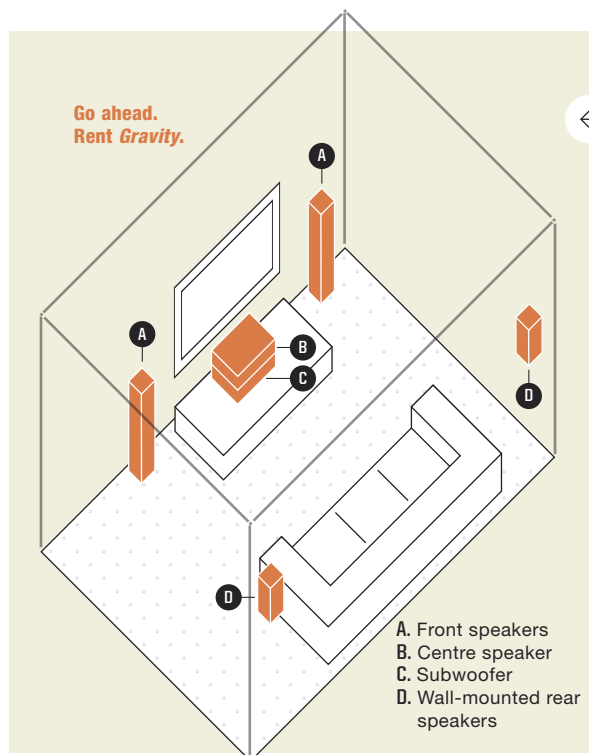
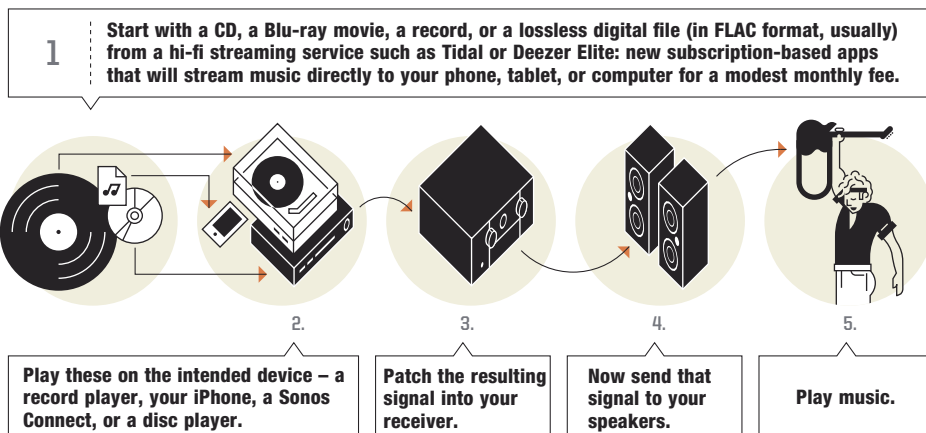
Marantz SR6009 Network A/V Receiver, R24 000

A receiver like this one processes any type of input you can think of – that record or Blu-ray player, cassettes, even HDMI inputs – and converts it into an analogue signal that will drive the sound through your speakers. This one can also stream music, like the Sonos Connect.



THE ULTIMATE SYSTEM

If any part of your audio set-up doesn't operate at hi-fi capacity, from the source file to the speakers, you can end up with distorted sound with the high and low ends lopped off. Whole bass lines can disappear. This is especially important for complicated, layered jazz, rock, and classical music, as well as for movies with overlapping effects and dialogue. To get the enveloping, detailed sound you'd hear if you were watching at a theatre or listening to a band live, you need a system like this.



SO YOU WANT TO WATCH MOVIES

To play both music and movies, you need a 5.1-channel set-up. That's five speakers, with a subwoofer acting as the bonus .1. Unless it's mixed for 5.1, your music will play on only two channels – your two largest speakers, plus the subwoofer. Movies incorporate complete surround sound, which includes two rear speakers and the centre speaker. The centre will play a dedicated dialogue channel, so you can hear what characters are saying over loud background music or action-related cacophony.

Assuming your TV sits in the centre of a wall, you want your biggest speakers on either side of the entertainment centre. Place a centre speaker console and the subwoofer under the TV. Place the rear speakers just behind you at ear level – about 80 centimetres when sitting – and parallel to the front side speakers. You can also mount these and point them downward. Now put in a movie on Blu-ray. The more explosions, the better.

HOW TO SHOP • You wouldn't buy a mattress on the Web without testing it in a store first, would you? Give your sound system the same respect. Take a couple of your favourite CDs to play. And take note of the listening room's acoustics. Most hi-fi stores are carpeted and absorb sound. If your room at home is all hardwood and bare walls, expect the speakers to sound significantly louder and more open there. (Also, maybe buy some art.)



5 EXCELLENT HI-FI STORES

THIRTEEN

Cape Town and Johannesburg

Distinctly non-mainstream approach to memorable audio experiences, in realistic listening rooms, from entry level true hi-fi to real high end, wrapped up with artistic flair – like Avant-garde Acoustics horns.

CELESTIAL SOUNDS

Stellenbosch

With a lineage traceable back to a NAD distributorship since 1979, this much more focused operation showcases the likes of Audio Exklusiv, Conrad Johnson and Jeff Rowland.

THE LISTENING ROOM

Johannesburg, Durban, Cape Town

If the names Eggleston-works, Eminent Technology, J A Michell and Manley mean anything to you, you've probably spent time at one of their outlets, which specialise in select brands.

AVG

East London

Perhaps an unlikely location for AV heaven, but Audio Visual Gallery has three decades in the business, servicing domestic and business clients.

OUTHOUSE AUDIO

Cyberspace

In the world of previously loved audio equipment, Andre Vermeulen is something of a legend. You'll find him on avforums.co.za and Gumtree.

SKILLS

THINGS COME APART

PHOTOGRAPHS BY
TODD McLELLAN



DISASSEMBLY REPORT: BLENDER

MODEL: WARING PBB212

PRODUCED:
McCONNELLSBURG, PA.

DISASSEMBLED:
TORONTO

NOTES:

Fred Waring was a big band conductor whose band, Fred Waring's Pennsylvanians, was the first to electronically record a song. When an inventor approached Waring to invest in his early blender, the Miracle Mixer, Waring tweaked and re-named the product. The Waring Blendor debuted in 1937. Odd spelling aside, it looked pretty much like what you see here.

NUMBER
OF PARTS:

87

TIME TO
DISASSEMBLE:

1 HOUR,
12 MINUTES,
2 SECONDS

- ① **DRIVE COUPLING:** The mechanical linkage between the motor and the blade. Made of die-cast zinc.
- ② **BAFFLE:** The fan pulls air in through the bottom of the base, cooling the motor. The baffle ensures that the heated air flows out the top of the base instead of recirculating around the hot parts.
- ③ **BLADE:** Not ordinarily removable, it's designed to last for at least 100 hours of continuous blending.
- ④ **BASE PLATE:** The five holes in the centre are for air intake.
- ⑤ **END-BELL BRACKET:** Holds the motor in a vertical orientation below the blade.
- ⑥ **UNIVERSAL MOTOR:** Can operate on either AC or DC power. On the blender's HI setting, the motor operates on normal AC. On LO the voltage is rectified down to 90 volts DC to decrease the speed of the blade.
- ⑦ **LID:** Made of a soft vinyl that forms a tight seal.
- ⑧ **JAR:** This is where the food goes, but you probably guessed that. The cloverleaf shape disrupts the vortex that forms in the blender to promote more comprehensive mixing. This jar is made of silica glass, which can handle a 90-degree temperature change.
- ⑨ **BLADE-ASSEMBLY GASKETS:** Made of Teflon to absorb impact from disorderly foodstuffs.
- ⑩ **NAMEPLATE:** Stamped metal that's riveted in place, the way it's always been.
- ⑪ **BASE:** This is made of electrostatically powder-coated, die-cast zinc, which keeps high-frequency motor sounds from annoying the dog.
- ⑫ **JAR-PAD STUDS:** These fasteners are inserted, pointy side down, into the entire base assembly, and bolted to the end-bell bracket to hold everything together. Then the red pads go on the wide ends to stabilise the jar.

— KEVIN DUPZYK

HOW TO MAKE AN UNEMBARRASSING BLENDER DRINK

If it's hot enough outside for ice cream, it's hot enough for a frozen beverage. But no one wants to be caught at the backyard braai drinking something pink and frothy out of a coconut. Yael Vengroff, beverage director at a top hotel bar, suggests making a Kentucky Maid, a riff on the mint julep, instead. "Frozen whisky drinks are rad," she says. "And it's green, so it's not a girly colour."

THE KENTUCKY MAID

→ To make, mix 45 ml high-proof bourbon, such as Old Grand-Dad, with 30 ml demerara simple syrup (two parts demerara sugar and one part water heated on low until the sugar dissolves),

25 ml fresh lime juice, six to eight mint leaves, three cucumber slices, and about a cup of ice, and blend until smooth. Garnish by poking a small mint sprig through a slice of cucumber.

SKILLS

AUTOMOTIVE



THE KIDS IN THE GARAGE

How to strip, repair, repaint and rewire an old car – with help from an after-school automotive club. Part five of a six-month series.

Junior Mike Vanderheiden uses skills he learnt in his dad's shop to remove the Camaro's drum brakes.

THE FIRST TIME Mike Vanderheiden, a 17-year-old junior at Freedom High School in Freedom, Wisconsin, disassembled a drum brake, he was 10, and it took him the whole day to put it back together. "As soon as I pulled off the drum, everything fell apart on me," he says. These days Vanderheiden's a pro, repairing trucks for his dad's business as a part-time job. His knowledge also comes in handy around Freedom High's garage, where he helps fellow students with less experience work on the drum brakes for the club's nearly complete 1974 Oldsmobile Delta 88 and 1981 Chevrolet Camaro Z28 project cars. Today Vanderheiden can reassemble a brake in just 20 minutes, which he learnt with the help of a smart trick: taking a picture first.



CAR SHOPPING WITH AN AUTO INSTRUCTOR When I was a kid my dad used to make me scrub the wheels on our beaters that we drove to races he worked. My job was to clean each wheel to get rid of brake dust. That stuff is just terrible. When I talk to kids about buying cars, it's one of the things I talk about. Semi-metallic pads leave an ugly black dust that stains and damages the wheel's finish. If I see this on a car I'm considering, it's a deal breaker. It's a sign of poor care. When it comes to something as important as braking, you want the best. — JAY ABITZ

HOW TO

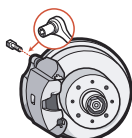
REPAIR A DISC BRAKE PAD

Tips from the
Freedom High School
Automotive
Programme.

Though most modern cars come with disc brakes, the Oldsmobile and the Chevrolet also have drum brakes. Freedom High's auto club works on both, so we asked them how to replace a disc pad.

STEP ONE

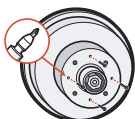
Remove
the brake
caliper.



With the car elevated and the wheel off, remove the brake caliper by taking out the caliper bolts with a socket spanner. Do not let the caliper hang freely or it could damage the connected brake line. Set the caliper on a raised surface instead.

STEP TWO

Replace the
rotor.



When changing brake pads, you must either machine the rotors smooth or completely replace them to prevent them from unevenly wearing the new pads. Rotors aren't very expensive these days, so it's usually wise just to buy new ones.

STEP THREE

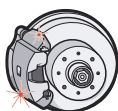
Compress the
piston.



The piston is the part of the caliper that applies the hydraulic pressure that presses the pads against the rotor, halting the wheels. Braking causes the piston to stick out slightly, so you'll need to compress the piston back into the caliper. With the old inner pad still in place, use a C-clamp to do this.

STEP FOUR

Reassemble
the brake.



Snap your two new pads on both sides of the caliper and slide it back into position over the rotor. Then use a torque wrench to secure the caliper bolts to the manufacturer's torque specification, which can be found in your car's manual. Your local parts supplier would know, too, if the manual's gone missing.

→ NEXT MONTH

FUEL LINE REPAIR

WIN! with our home workshop challenge

AND ANNOUNCING:

Workshop Challenge No. 3

Accept the **PM Home Workshop Challenge** and a **Makita DHS710 Cordless Circular Saw** hamper, valued at **R8 000**, could be yours.

THE THEME: LOADSHEDDING

It's load shedding and you're left with 2½ hours of downtime. Or... you could complete a winning project. **THE CHALLENGE:** A project that, as far as possible, uses no AC mains power directly to design and build. Battery-operated rechargeable tools are fine, as are hand tools, of course. You score extra brownie points for a project that can be completed in 2½ hours, that uses no AC mains power *anywhere* in its timeline (including production of the raw materials) and that mitigates the effects of load shedding.

THE PRIZE:



The **Makita DHS710 Circular Saw** (185 mm) is powerful, lightweight, well balanced and ideal for cutting roof rafters, sheeting and more. This model is powered by two 18 V batteries, installed in series, that supply energy to the powerful 36 V DC motor drive system.

The DHS710 has a maximum cutting capacity of 68,5 mm at 0 degrees and 49 mm at 45 degrees. The locking guide makes it easy to adjust the depth of cut required, while the convenient blower function at the front of the machine directs sawdust off the cut line for a better cutting view.

Operator comfort and more control during operation have not been overlooked. An ergonomically designed handle with soft grip reduces vibration and hand fatigue.

Included in the prize are a **Makita DHS710 circular saw**, two x 3,0 Ah **Makita lithium-ion batteries** (BL1830 recharge time is 22 minutes per battery) and a **Makita compact fast charger** (DC18RC).

To find out more, visit www.makita.co.za, like Makita on Facebook **Makita-PowerToolsSA** or call 011 878 2600.

Your project will appear in a future issue of **POPULAR MECHANICS**.

Email your plans and a picture of the results to popular_mechanics@ramsaymedia.co.za by **21 August, 2015**.

For full competition rules, see www.popularmechanics.co.za/workshopchallenge

Makita **Popular Mechanics**

WIN one of three Bosch hampers valued at R9 658 each

Take your home workshop to the next level with the four smart, versatile and ergonomic tools contained in each hamper:

Bosch PBD 40 bench drill

The Bosch PBD 40 is all about control. Its two-speed electronic speed/torque setting and robust base plate with predefined fixing points ensure maximum stability. But it's convenient and easy to use, too, with a laser function and LED display that monitors drilling depth (in mm) and speed (in r/min). The detail: chuck clamping range 1,5 mm to 13 mm; maximum drill stroke 90 mm; maximum drilling capacity 13 mm (steel) and 40 mm (wood).

Bosch PWS 850-125 angle grinder

Unlike other angle grinders, this one is designed for comfort and convenience. Its new compact design, ergonomic anti-vibration handle and a new seal at the rear bearing are all aimed at minimising user fatigue, for instance. An integrated spindle lock facilitates disc changes and the protective guard is easily adjustable to ensure maximum user safety.

Bosch PCM 1800 SD Sliding Compound Mitre Saw

The Bosch PCM 1800 SD boasts a powerful 1 800-watt motor, dual bevel mechanism and 250 mm saw blade. As a result, it's ideal for high-capacity cross cutting, bevel cutting, mitre and double mitre cutting through wood and aluminium. The combination of a high-quality saw blade and integrated laser with horizontal imprint scale achieves smooth and accurate sawing results.

Bosch PHO 1500 planer

The Bosch PHO 1500 has a depth cut of between 0 and 1,5 mm and offers users a clean work surface, thanks to the one-sided chip clearance, which allows for vacuum cleaner access. The intelligent blade system makes changing the tungsten carbide planing knife a snap. At just 2,4 kg it's nice and manoeuvrable, too.



TO ENTER, ANSWER THE FOLLOWING QUESTION:

QUESTION: What is the power in watts of the Bosch PCM 1800 SD Sliding Compound Mitre Saw?

SMS the word **BoschDIY**, followed by the answer, your name and email address to 32697 (R1,50 per sms; this service does not allow for 8ta numbers). To enter online visit our Website at www.popularmechanics.co.za.

Competition rules:

1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia. **2.** Only one online entry per person. You may enter via SMS as many times as you like (SMS charged at R1,50). **3.** Competition runs until 31 July 2015. **4.** We will draw the winner(s) on 5 August 2015. **5.** The prize is not redeemable for cash. **6.** Prizes not claimed within 3 months will be forfeited. **7.** The judges' decision is final and no correspondence will be entered into. **8.** Regrettably, only South African residents are eligible for prizes. **9.** By entering this competition, you agree to receive future correspondence from POPULAR MECHANICS. You can opt out at any stage by: (a) Sending an e-mail containing the relevant details with the subject line "opt out" to pmmailers@ramsaymedia.co.za; or (b) Sending an SMS including the word "STOP" to 31699. Standard SMS rates apply.



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PROJECT



The handsome log rack

How to transform a maple tree and some steel into a functional piece of art.

BY ROY BERENDSOHN AND MIKE CUNNINGHAM



PHOTOGRAPHS BY JARREN VINK

Man, it's chilly. What kind of weather we got out here, a blizzard? Why don't you reach into that log rack, pull out a split and start a fire for us? Why, yes, thank you, it is a nice log rack. We built it out of a poorly located tree and a pile of raw steel. Added a little wood stain, but left the screws and the metal unfinished so it would look utilitarian. Not so utilitarian that it's out of place in an elegant room, but, you know, a little rough. Brawny. It's a piece of furniture that says, I could navigate a toolshed in the dark, but couldn't find my way around an @Home megastore with an iPhone, a compass and a map. This, it should be noted, is an impressive feat for furniture.

Materials

PART	QTY.	DESCRIPTION	DIMENSIONS
A	2	Steel upright	6 x 40 x 1100
B	4	Steel cross support	6 x 40 x 400
C	2	Hardwood log	6 x 40 x 400
D	8	Button-head machine screw	8-24 x 20
E	4	Spax lag screw	6 x 75 T30
	1	Pint pre-stain wood conditioner	
	1	Pint oil wood stain	

STEP 1

Bend the uprights

First, find a friend. To make the uprights that will hold your firewood, you'll need to bend two 1,2 m pieces of 25 mm flat steel, which you can buy at a hardware store, into U shapes and you can't do it alone. Using a bar clamp, arrange the first piece of steel next to an old tyre rim so that it looks like a P (Fig. 1). Now clamp the rim in a big bench vice. Have your friend pull the long end of the steel around the curve. As it starts to come around, grab the bar and pull while your friend pushes. Once the steel is roughly U-shaped, remove any unevenness: Clamp the U in a bench vice and sight down the side to check for any vertical twisting. Use your hands to bend that out. Next, cut both ends of the U so that they're even (Fig. 2). Use a hacksaw or a circular saw with a metal-cutting blade. Now repeat this whole process for the other U. Next, cut the four cross supports to length and bore 8 mm bolt holes into both ends of each. Use those holes to mark the position of the holes in the upright legs of the Us. If you have a letter-size drill-bit set, use the I-size bit; otherwise, use a 7 mm size drill. Add threads to these holes with an 8 mm-24 tap and a large tap-wrench handle (Fig. 3).

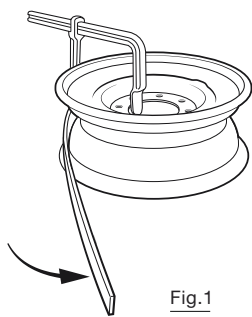


Fig. 1
Bending the steel

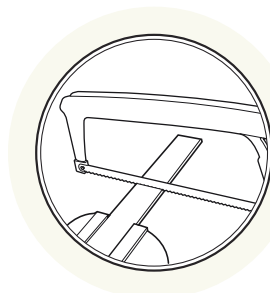


Fig. 2
Evening out the U

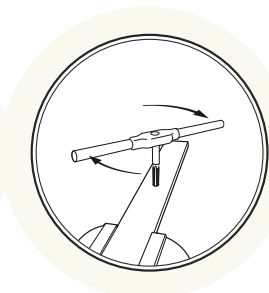


Fig. 3
Tapping screw holes

EQUIPMENT

- Bar clamp
- Car wheel rim
- Chainsaw
- Chisel
- Corded drill
- Drawknife or putty knife
- Drill bit
- Hacksaw
- Right-angle grinder and abrasives
- Screwdriver bits
- Tap and tap handle
- Tap lubricant
- Disposable paintbrush
- Sandpaper or abrasive discs

TIP

Don't skip on the lubricant when adding threads to the holes for the machine screws. Lack of lubricant can result in a stuck or broken tap.

THE PROJECT PLAYLIST

Because you are not going to build this log rack in silence.



Sturgill Simpson
"Life of Sin"

A reincarnation of Johnny Cash – with a drawl that makes everything he sings sound like, "Whaddaya say, man, another beer break?"

Dinosaur Jr.
"Start Choppin'"

A cult classic that's like an alarm you set for noon on Sunday, just to make sure you don't sleep all day. Easy but urgent.

The Neighbourhood
"Sweater Weather"

A young-couple-against-the-world anthem, in which Jesse Rutherford lets his girl warm her cold hands in the sleeves of his sweater.

The Walkmen
"Heaven"

Lush, woodsy, and nostalgia-inducing, like a barn party with a really excellent bonfire.

Pearl Jam
"Getaway"

A driving ode to getting things done your own way.

The Rolling Stones
"Beast of Burden"

One of the best songs to do just about anything to.

The Black Keys
"Gold on the Ceiling"

Organ riffs, snarly guitars, and a beat like a train engine should get you through any late project slump.

Tompall Glaser

"Put Another Log on the Fire"
A tongue-in-cheek account of what might happen if you ask your wife to do your chores for you.

STEP 2

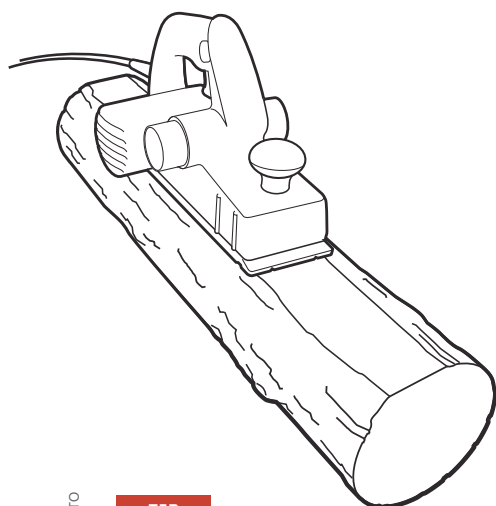
Create the log base

Gently assemble the rack, lining up the parts with a carpenter's rafter square. Don't tighten the machine screws yet. You'll need to take everything apart to deburr it before final assembly.

Debark two logs with a putty knife if the wood is seasoned, or a drawknife if the logs are green. Use a plane to flatten the bottom of the logs (Fig. 4). You'll take off about 12 mm of wood. Sand the logs with 60-, 80-, and then 100-grit paper.

Mark the place where the U-shaped uprights will sit on the logs, and notch the logs with a chainsaw or a large chisel; then smooth out the notches with a chisel or a wood rasp, if you own one. Where the rack meets the logs, mark the position for one 8 mm hole in each U-shaped upright for a 6 x 75mm Spax lag screw. Drill each hole. Test-fit the rack to the notched logs and adjust the notches if needed. When everything fits, disassemble the rack.

Fig. 4
Planing the logs



TIP

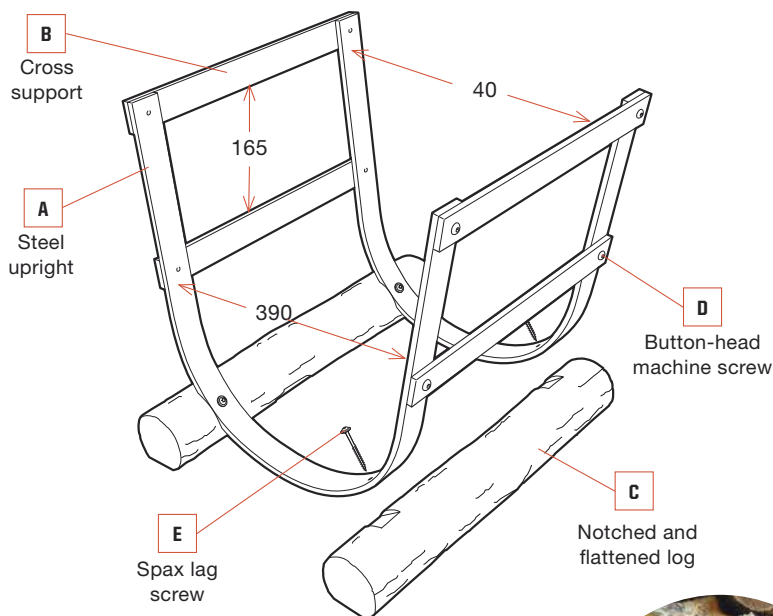
We used a power plane to give our logs a flat base, but if the logs are smooth and of a consistent diameter, you can also feed them through a small benchtop planer.

STEP 3

Finish and assemble the logbase

Apply a coat of pre-stain wood conditioner to the logs. When that's dry, brush on a coat of wood stain. Grind the metal parts smooth using sanding discs and an angle grinder. Start with 24-grit and work through 36-, 40-, 60-, and 80-grit. If you want a polished look, do the final sanding with 100-grit.

Finally, bolt the metal rack together and firmly tighten the machine screws. Grind the screws flush on the inside of the rack with a 24-grit disc and smooth off any rough areas. Use the lag screws to connect the rack to the finished logs. There you have it – a new log rack. Now all you need to do is fill it. Maybe the kids could help with that.



THE BURNING QUESTION

What's the best wood to burn in your fireplace? Here's what the folks at Designer Fireplaces have to say.

In South Africa, firewood is readily available because it is naturally abundant and thanks to the initiative of many roadside informal vendors. But when you stop to buy a load of wood on the side of the road (or even from a reputable outlet) what should you look for to ensure you get the best firewood? What makes good firewood?

The truth is, the best wood to burn is always well-seasoned wood. This is even more so if you prefer to burn hardwoods. Well-seasoned wood creates less creosote build-up and makes for a better cleaning cycle.

Can you buy well-seasoned wood in South Africa? The fact is, most wood sold in South Africa is "fresh" and can do with a fair amount of seasoning time. If possible, buy your firewood before the winter season to ensure that your wood is ready to burn come the first cold snap.

WHAT TO LOOK FOR:

- Seasoned wood must look dark or grey when compared with green wood
- If you split a piece of seasoned wood it should be white on the inside
- Well-seasoned split firewood should be reasonably brittle and have cracks running through it
- There should also be a lot of little cracks on the inner rings.

When storing wood for seasoning, never cover it with a tarpaulin or canvas. This prevents proper evaporation and hinders the wood seasoning process.

To find out more, visit www.designerfireplaces.co.za



FIREWOOD FACT

Firewood heating value is nothing more than a measure of density. Pine, for instance, does burn hot; the problem is that it burns very fast and therefore is not very good for heating your house.



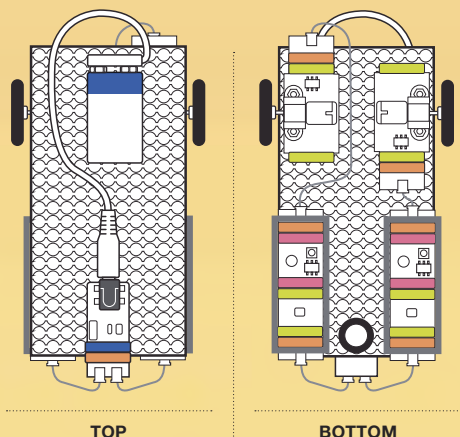
Daniella Gomes, 13, a budding engineer from Staten Island, New York, calls littleBits founder and CEO Ayah Bdeir, left, “super-inspiring.”



A SNACK-SERVING ROBOT!

Delivers candy or chips (or fruit) to everyone at the table.

DESIGNED BY LITTLEBITS



FOUNDED BY MIT Media Lab alumna Ayah Bdeir in 2011, littleBits has become a force in the world of STEAM education. The company name describes its products: colourful electronics components as easy to assemble as Lego bricks. It’s a joy to connect the power modules, motors, sensors, LED lights, and other out-of-the-box parts, creating a single unit that seems to come to life. It’s so much fun, in fact, that you wouldn’t know you were learning fairly sophisticated lessons in circuitry, automation, and robotics.

Daniella Gomes, 13, studies these things at Saint Clare School in Staten Island, New York, and was on the 2015 regional First Lego League robotics winning team. “I want to be an engineer,” she says. “I feel like I can make anything.”

And so, with Bdeir’s assistance, Gomes built the snack-serving robot. It incorporates six littleBits components, which are sold via the company’s website. Two bright LEDs and light sensors rigged to motors keep

DIFFICULTY: EASY REASONABLE HARD
TIME: 2 hours **AGE:** 12+

the robot moving along a line of black electrical tape. “The sensors”, Bdeir says, “control the robot’s speed and direction by regulating the motors.”

The relative brightness of the light detected by the sensors (low from the dark tape, high from the surrounding area) causes them to make the motors turn fast or slow. The robot

veers in the direction of the slower motor, just like a rowing boat turns towards the oar that paddles slower

than the other.

Gomes found building the bot straightforward (littleBits snap together with magnets), but calibrating the sensors to keep it on track was tricky. “I usually do that with programming,” Gomes says. “Working with the sensors was really cool.”

Almost as cool as having a robot deliver candy to you.

Watch a short video on how to make this project at popularmechanics.com/little-bits-project.

PHOTOGRAPH BY DAVID BRANDON GEETING

Materials

QTY. DESCRIPTION

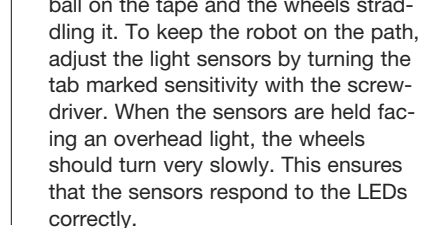
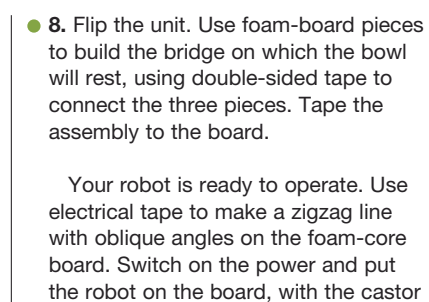
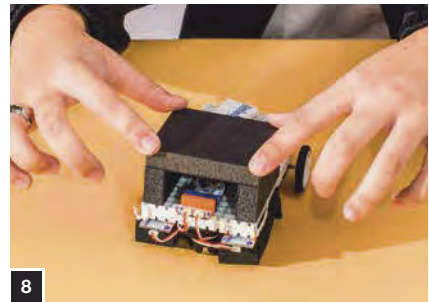
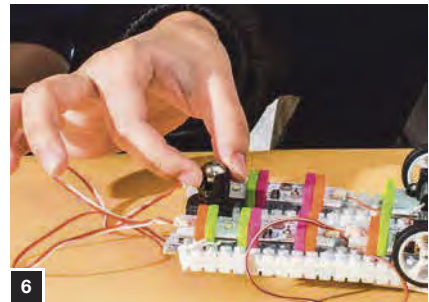
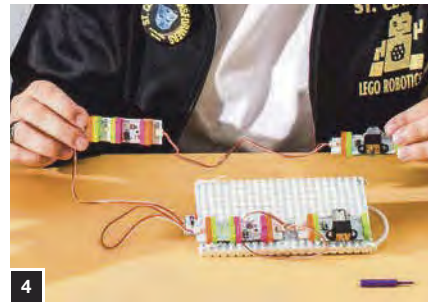
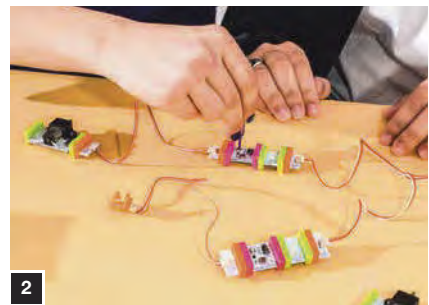
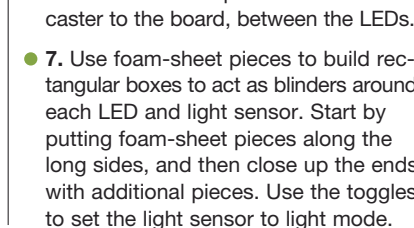
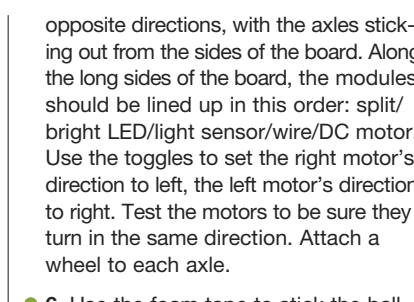
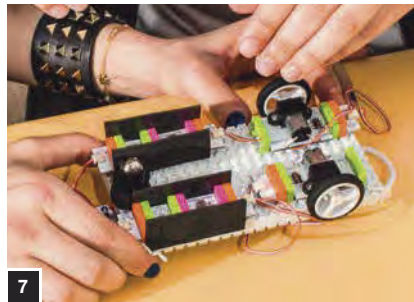
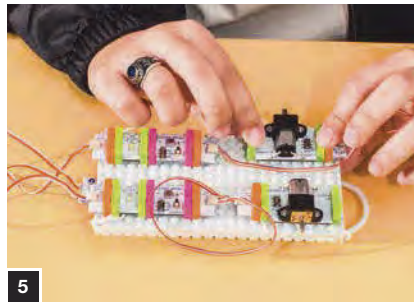
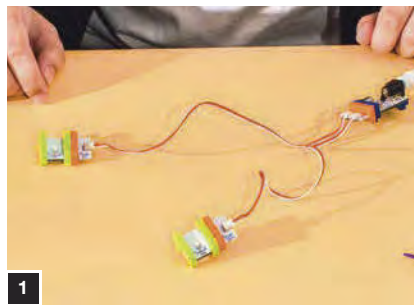
1	LittleBits split
2	LittleBits bright LEDs
2	LittleBits DC motors
1	LittleBits screwdriver
1	LittleBits power module
2	LittleBits wires
2	LittleBits mounting boards
2	LittleBits light sensors
1	9-volt battery and littleBits cable
4	Twist ties
1	600 x 900 foam-core board
1	Roll black electrical tape
1	Adhesive foam sheet
1	Lightweight snack bowl
1	Roll double-sided adhesive foam tape
1	Pololu ball caster with 20 mm metal ball (No. 995)
2	7 x 32-mm Pololu wheels (No. 1088)
3	Pieces 12 mm foam board (two each 25 x 65, one piece 65 x 70) to build U-shaped bowl holder

To receive a discount on parts, use the promotional code POPMECHSNACK at <http://littlebits.cc/projects/snack-robot>

Instructions

● parent only
● parent and kid
● kid only

1. Build a circuit by connecting parts in this order – battery and cable, power, split – and then attach one bright LED to each terminus of the split.
2. To each bright LED connect the following units in this order: light sensor, wire, DC motor.
3. Hold the mounting boards back-to-back, line up the holes in each corner, and fasten the boards together using a twist tie threaded through the holes. Lay the boards on the table, and press-fit the power-and-split coupling in the middle of the edge of a short side of the board. Be sure to centre the parts on the edge to ensure that your robot will be balanced.
4. Flip the boards over and press-fit the LED/light sensor/wire assemblies into two corners, with the white rectangles protruding from each split at the edge of the shorter side.
5. Align the DC motors with the LED assemblies and press-fit into the same mounting board. Orient the motors in



opposite directions, with the axles sticking out from the sides of the board. Along the long sides of the board, the modules should be lined up in this order: split/bright LED/light sensor/wire/DC motor. Use the toggles to set the right motor's direction to left, the left motor's direction to right. Test the motors to be sure they turn in the same direction. Attach a wheel to each axle.

6. Use the foam tape to stick the ball caster to the board, between the LEDs.
7. Use foam-sheet pieces to build rectangular boxes to act as blinders around each LED and light sensor. Start by putting foam-sheet pieces along the long sides, and then close up the ends with additional pieces. Use the toggles to set the light sensor to light mode.

8. Flip the unit. Use foam-board pieces to build the bridge on which the bowl will rest, using double-sided tape to connect the three pieces. Tape the assembly to the board.

Your robot is ready to operate. Use electrical tape to make a zigzag line with oblique angles on the foam-core board. Switch on the power and put the robot on the board, with the caster ball on the tape and the wheels straddling it. To keep the robot on the path, adjust the light sensors by turning the tab marked sensitivity with the screwdriver. When the sensors are held facing an overhead light, the wheels should turn very slowly. This ensures that the sensors respond to the LEDs correctly.

SKILLS

With the right equipment, like this vintage workshop cabinet, organisation can be beautiful.



ASK ROY

POPULAR MECHANICS' senior home editor solves your most pressing problems. BY ROY BERENDSOHN

My tools are in constant disarray. I often can't find what I need, and when I take my tools somewhere, I usually misplace something. Can you help?

I've been there. I have tools for carpentry, finish carpentry, furniture-making, plumbing, electrical, masonry (concrete, brick, and stone), basic tile work, drywall, painting, general metalwork, welding, and demolition. That's a lot of tools to keep track of.

To make sure I know where everything is, I separate my tools by task and write the contents of a toolbox on the end of it in marker pen. The box may be marked as generally as "plumbing" or it may be marked more specifically as "drills and taps".

When I bring tools for a specific task, I bring the correct box and treat it like a mother ship. I moor

it near where I'm working and ferry tools to and from it using a tool tray or two. For example, if I change a tap, I take all the tools that I need to replace the tap out of my plumbing box and put those in the tray. Then I don't have to root around in the main box to find what I need, so everything stays more neatly arranged, including my sanity.

I have two acrylic basins in a bath vanity. The one I use more often is slightly yellowed. The other one looks brand-new. How can I remove the discoloration so they match?

Acrylics can be tough to clean. Your water's mineral content, the type of soap used, and residue from cleaners can combine to leave a hard-to-remove film.

Use what the manufacturer rec-

ommends. Generally this will be a non-abrasive gel cleaner. Apply it to a dry surface, allow the gel to dry, and then gently buff off the hazy finish. It's a lot like polishing your car, actually.

We got a good deal on a house sold as is, but it has wall-and-ceiling discolouration and some damaged door and window trim caused by a water leak from an ice dam. How do we fix this?

This isn't something that happens widely in South Africa, but it can occur in certain parts of the country – particularly the higher-lying parts.

Before you start concealing the cosmetic damage, you first have to make sure the leak won't start again. Ice dams are caused by heat escaping through a house's attic and melting snow on the roof. This causes a trickle of water to run down the roof, insulated by the snow above it, until it freezes when it reaches the coldest part of the roof, the eaves. There the ice builds up and a pond of water forms behind it, eventually leaking down into the attic. To prevent this from happening again, you need to install soffit and ridge ventilation, as well as more insulation in the attic. The vents will allow cold air to enter at the eaves and exit at the ridge, keeping the roof deck cold. And the insulation will prevent heat from escaping the rooms below. Together these measures will prevent the melt that caused the leak last time.

The discoloured wall and ceiling are easy to fix. Prime the affected areas with a stain-blocking primer-sealer. Cover that with a wall-and-ceiling paint. As for the trim, if it has a clear finish, it's not likely that you'll be able to easily restore its colour. You can paint it or replace it. If the trim has swelled and worked loose, nail it firmly, sink the heads, and fill them. Sand the filler smooth. Prime the trim with a shellac-based or alkyd primer and apply a top coat. If you fixed the dam correctly, that should take care of it.

PM



TELL ROY

A reader tip inspired by a recent Ask Roy topic.

Peter Scott, a custom woodworker, has this to say about producing a flawless bead while caulking a backsplash: "Put down masking tape on both sides of the joint, leaving about 2 mm each of backsplash and counter exposed. Once you've laid the caulk, smooth any inconsistencies with your finger. Peel away the tape after the bead has set up."



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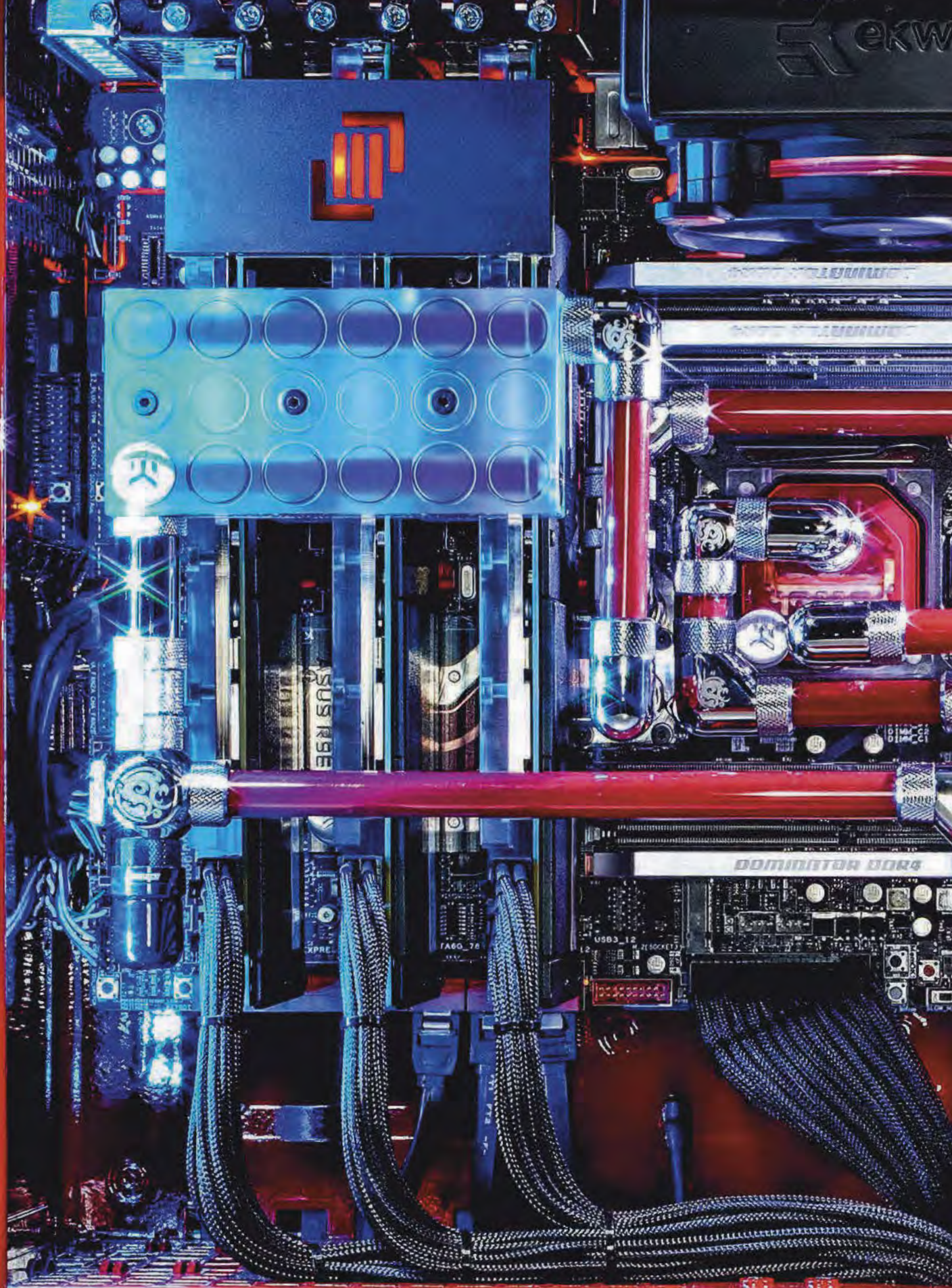


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Market Street in Kenilworth, New Jersey, about a half-hour drive west from Manhattan, is not a sprawling co-working campus somewhere in Silicon Valley, nor is it an imposing factory in New Taipei. Yet in one of the unassuming warehouse buildings that line this drag, tucked among the auto-glass repair shop and the industrial-supply company and the diner, the techno-craftsmen of Maingear Computers do the unexpected (for New Jersey): they create monolithic desktop towers, and they do it by hand.

Wallace Santos grew up in nearby Kearny and originally wanted to be a mechanic and soup up cars. He eventually went to school to become a network-systems professional. Santos was 18 when, in 2002, he merged the two and started making modified computers. He'd put together chips and processors built for the graphics and demands of intense gamers, artfully arrange the hardware and guts inside, and take the chassis to a panel shop to have them specially painted. Thirteen years on, Santos has 25 technicians who build high-performance machines for customers as varied as professional e-sport gamers, Wall Street traders, and individual enthusiasts. They've got their own paint facility in the building now. A guy who used to do custom

work on Ferraris details the exteriors.

At the facility, one man is assigned to see the build of a computer through to completion. It takes about three days. New technicians sit beside a long-timer for a month apprenticing, learning how to build the machine before they're allowed to make a computer of their own. The cooling system is something of a hallmark. When you're running three graphics processing units that put out 4K-resolution graphics with incredible speed, you generate enough heat to keep a small room warm. Heat is the biggest impediment to optimal performance, so liquid cooling lets you pump non-conductive liquid around the computer's key components. The liquid carries away the heat, which is pushed out of the computer by silent fans at the top and bottom of the chassis. Rather than setting up the liquid cooling in the usual sloppy vinyl tubes, Santos and Sean Cadet, who heads product development, created a loop of acrylic hard tubing around the PC components, the fittings made of custom chrome, and trimmed it all with a strip of remote-controlled LED lighting. It's the flourish of a dedicated gearhead. If you're going to make a machine that performs like a Formula One racer, it ought to look like it. –

MATT GOULET

A BEAUTIFUL THING

THE MAINGEAR
SHIFT

COMPANY: Maingear
LOCATION: Kenilworth, New Jersey
OWNER: Wallace Santos



Contributing editor
and fine woodworker
Richard Romanski in
his studio, a former
church built in 1875.
We plan to publish
his exclusive custom
workbench project
later this year.

THE ULTIMATE WORKSHOP

A great workshop is both functional and personal, a creative space packed with tools. In this definitive guide, you'll find advice on what those tools should be, where they ought to go, and what you can do with them. Whether your workshop is a renovated historic church (like this one) or a corner of the garage, we show you how to create a space that will allow you to make just about anything.

The Church AN INTRODUCTION

I WASN'T LOOKING FOR A CHURCH. It just came into my path. I think it was 1978. Could've been '79. The door hadn't been opened since the mid-sixties, but when I first saw it, it knocked my socks off. I said, why not? I could make use of this place. Sure!

The building was what you might call exposed to the elements, but the interior was intact and the structure was sound. The pews remained, so you had a sense of what it felt like in that congregation. It was just this vast space, a structure that still retained its history, so that when you walked through the doors you knew there had been some life in this space, and that things happened here. I just had to figure out how to

make it work for me.

That's the real and only question for any work space. How are you going to make it work for you? And all the questions that go with that. Is there enough light? Is there natural light? Is there air? If there's not, you have to say, Huh, how am I going to make this work? That goes for a huge church or 2½-metre corner of the garage.

The interior grew with time. I added partitions based on function and need. Creating smaller spaces allows you to organise. That bigger space might be for larger, basic tools – the band saw, table saw, jointer, the radial arm saw, the wood lathe. The smaller workbench space is where the hand tools are, maybe off to the side or around the periphery. There is economy in maintaining a space, because when you have a smaller space you can control the light, you can control the heat, the air.

I've never really had a master plan. You have to live with a space to

THE SHOP RULES

A tool is only as good as its blade or bit.

Drywall screws are for construction sites.

Always mark



learn how to use it. It's evolved. I've evolved.

Let's say you're doing a lot of sanding. You're beyond hand sanding – you've bought a disc sander, then you've got a wide belt sander, then a pneumatic drum sander. If you have one on one shelf and one on a table across the room, it doesn't make sense. You want to group them to control the dust. So you create that place within the larger environment, keeping the dust away from, say, shelves where you store a lot of small parts or the table where you apply finishes. Maybe you wheel your sanding equipment around on a cart. It may not end up where you thought it would work for you. You customise the room to what you like to do and how you like to do it. There are no rules.

Look for hidden storage. Use every nook. I have a wall of shelves where I keep handheld power tools. Rather than build the shelves out from a flat wall, I took advantage of the depth of the wall and created simple inset shelves. As time goes on and you gather more, you might need more shelves. But the key is, they have a home. Organisation is quieting. When things are piled in a corner and don't get looked at, that's disrupting. You look at that corner and think, "Oh my God, when am I going to get to that thing?" However big or small your workshop might be, it has to be a place that, when you walk away at the end of the night, you know it's okay. And when you come back the next day or the next weekend, there's a sense of order.

I don't think I ever lose sight of the beauty of this place, the magic. I can be here and just see the light coming through that window at a certain time of the year, a certain time of the day, the light is filtered by these particles in the air, and there's some phenomenon that happens. No matter what you're doing – and it could be really important – you step back. You pause. You're in this big space or this little space, and you're all by yourself. And you can create.

Because that's the point, isn't it? That's why I have such respect for this space, the routines and patterns of it. My vocation, what I do, is solving problems. That's what design is. And I feel that when I'm out here, I can solve any problem in the world. – RICHARD ROMANSKI

Maker 01 Fact 02

9 The number of Maker Libraries operating across cities in the UK and South Africa as part of the Maker Library Network. Designed as creative spaces for making, showing and reading, Maker Libraries share three key elements: a library (duh), a makespace and a gallery. Initially developed as part of the British Council's Connect ZA season to connect designers and makers in the UK and South Africa, the Network is currently expanding globally.

More: makerlibrarynetwork.org

THE CORE

The essentials of a well-equipped shop, and three options for each.



MITRE SAW

TABLE SAW

MUST HAVE

R

Crosscuts construction timber, mouldings, or wood for furniture. Put a specialised blade on it and it also cuts plastic pipe and copper tube.

Craftsman 1725CMSW

180 mm compound mitre saw
7 amps

Maximum capacity

- Straight crosscut, no bevel:
50 x 100 mm
- 45-degree mitre, no bevel:
50 x 73 mm

RR

Makita LS1040

250 mm compound mitre saw
15 amps

Maximum capacity

- Straight crosscut, no bevel:
70 mm x 130 mm
- 45-degree mitre, no bevel:
35 mm x 90 mm

RRR

Bosch GCM12SD

300-mm dual-bevel glide mitre saw
15 amps

Maximum capacity

- Straight crosscut, no bevel:
100 x 350 mm
- 45-degree mitre, no bevel:
100 x 350 mm

In garages, and professional workshops alike, rips and crosscuts timber and shapes parts for woodworking joints.

Ryobi RTS10

250 mm table saw
15 amps

Maximum capacity

- Depth of cut at 90 degrees:
75 mm
- Depth of cut at 45 degrees:
67 mm
- Rip: 300 mm, right of blade

Craftsman JT2504RC

250 mm table saw
15 amps

Maximum capacity

- Depth of cut at 90 degrees:
75 mm
- Depth of cut at 45 degrees:
65 mm
- Rip: 300 mm, right of blade

SawStop CNS175-SFA30

250 mm table saw (with blade-stop safety feature)
14 amps

Maximum capacity

- Depth of cut at 90 degrees:
80 mm
- Depth of cut at 45 degrees:
57 mm
- Rip: 750 mm, right of blade

Phrases you never want to hear in a man's workshop

Squinting is the same as wearing safety glasses.

This all-in-one stain and polyurethane is probably just as good.

I threw the owner's manual away years ago. So bulky!

You're telling me I should have measured the opening for the



DRILL PRESS



PLANER



JOINTER



BAND SAW

► NICE TO HAVE

Makes holes quickly and accurately in wood and metal. Makes you wonder how you ever got on without one.

Harbor Freight Central Machinery 60237

250 mm benchtop drill press
3,9 amps

- Twelve speeds
- High speed: 2 900 r/min
- Low speed: 300 r/min

Craftsman ZJQ4116D

300 mm benchtop drill press
4,8 amps

- Twelve speeds
- High speed: 3 065 r/min
- Low speed: 355 r/min

Shop Fox W1669

860-mm benchtop drill press
5 amps

- Five speeds
- High speed: 3 470 r/min
- Low speed: 550 r/min

Controls the thickness of solid timber. With some finesse and a few tricks, also flattens stock.

Harbor Freight Central Machinery 95082

Two-knife thickness planer
2,5 amps

Maximum capacity

- Width: 300 mm
- Height: 112 mm
- Depth of cut: 2,5 mm

Delta 22-555

Two-knife thickness planer
15 amps

Maximum capacity

- Width: 325 mm
- Height: 150 mm
- Depth of cut: 2,5 mm

DeWalt DW735

Three-knife thickness planer
15 amps

Maximum capacity

- Width: 325 mm
- Height: 150 mm
- Depth of cut: 3 mm

Flattens a wood surface that becomes a reference plane or an edge to be glued to another. Or it yields a surface that simply looks nicer without saw marks.

Shop Fox W1829

150 mm benchtop jointer
12 amps, 1,1 kW

Maximum capacity

- Depth of cut: 3 mm
- Cuts per minute: 20 000
- Knives: two

Ridgid JP0610

155 mm benchtop jointer
6 amps, 0,75 kW

Maximum capacity

- Depth of cut: 3 mm
- Cuts per minute: 15 000
- Knives: three

Jet JJ-6CSDX

150 mm jointer
13 amps, 0,75 kW

Maximum capacity

- Depth of cut: 12 mm
- Cuts per minute: 14 400
- Knives: three

Cuts curves and also resaws (cuts wood into thinner sections while wasting less wood than thickness planing).

Craftsman 21400

250 mm band saw
0,25 kW

Maximum capacity

- Width: 245 mm
- Height: 118 mm

Jet JWBS-100S

250 mm band saw
0,375 kW

Maximum capacity

- Width: 245 mm
- Height: 105 mm

Delta 28-400

350 mm band saw
0,75 kW

Maximum capacity

- Width: 345 mm
- Height: 150 mm

door before we built this part?

I'm pretty sure the order doesn't matter on the distributor.

Don't waste your

time. I already measured that.

Golly, that saw is waaaay too loud.

Spark plugs aren't supposed to be easy

to screw in. Just force it. It's fine.

You got to smell this glue!

Epoxy can't be that hard to get off.

Why wouldn't a belt sander work on a bunion?

Those were my good decoupage scissors!

Oh, here it is: the

instructions say we should open the windows... two hours ago.

Pilot holes are for sissies.

You don't need a mask; sunglasses work just as well for welding. Really.

Please don't tell me we missed Ellen.

You need at least one square that has machinist-level accuracy.

More sawhorses.

Always, always safety glasses.

Useful storage

How to decorate your workshop

When in doubt: pegboard.

If you choose to put up old licence plates, they should be from cars you have owned, not things you found on Bidorbuy.

If your calendar consists of cars, models, models on cars, or model cars perhaps you need to check the date on it (we mean the century).

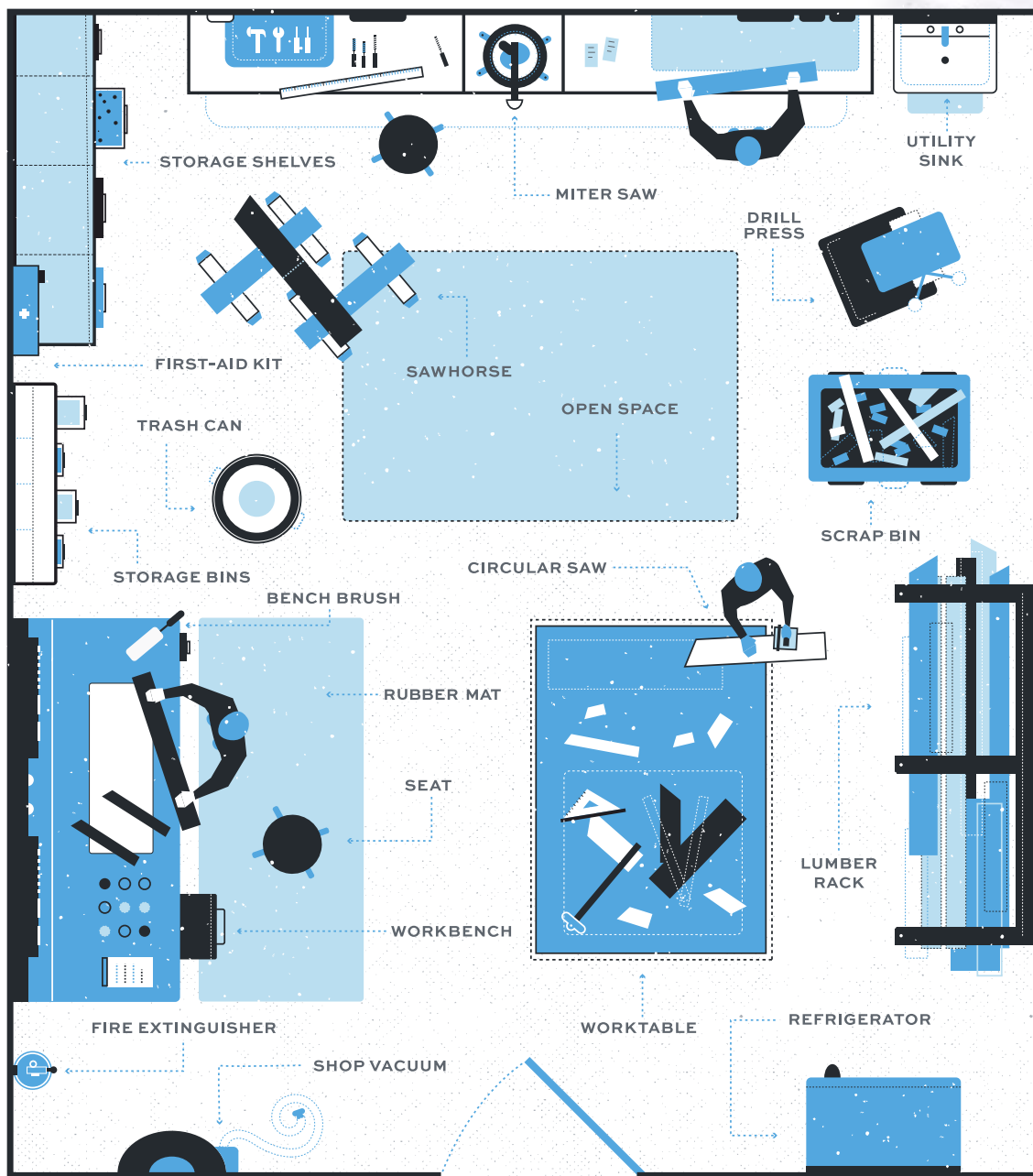
Do you have a high school banner? Put it up.

No TV. But you will need a radio – preferably something analogue, with a long, slightly bent telescoping antenna.

Metal filling-station decals are always good.

You can never go wrong with more lighting.

Hang a set of labelled bathroom keys. Not because you'll use them, but because you are witty and fun.



THE WORKSHOP
HALL of FAME



The portable workshop

The Lotus Elan and the Black & Decker Workmate have one thing in common: both were designed by Ronald Hickman, a South African who left his native country to design cars in England. He was also an avid tinkerer and an amateur builder. While working on a DIY project at home in 1961, he was sawing a piece of timber on an expensive chair and sawed

containers: coffee cans, Mason jars, peanut butter jars, apple crates, shoe boxes, cigar boxes, lozenge tins. No shop is complete without a

Issue/Not an issue

ISSUE
NOT AN
ISSUE

Can't find hammer	X	
Spilled paint		X
Hammered your thumb	X	
Cordless drill is dead		X
Dinged your workbench		X
Stripped a screw		X
Lost track of time		X
Lost track of time and missed brunch with your wife's friend		X
Got a quick shock		X
Mixed cleaning products	X	
The workshop vac is full		X
Spilled oil	X	
Cut finger (shallow)		X
Cut finger (deep)	X	
Cut finger (off)	X	
Learned the meaning of arc flash	X	
Cut too short	X	
Cut too long		X
The kids came in		X
Forgot to buy post-project beer		X

THE FLOOR PLAN: A WORKABLE MODEL

A man must make his workshop his own, but there are guidelines.

Store timber, metal, pipe, and all raw materials as close to the entry point as possible.

Make provision for scrap storage and trash. Use 3-mil contractor-grade refuse bags for storing sharp and bulky debris. Build a box from 20 mm plywood mounted on castors for storing and moving large and heavy amounts of scrap.

Open floor space allows you to break down material with a circular saw.

Benches can be mobile or secured to a wall.

Height: For traditional hand-tool woodworking, 800 to 850 mm. For light metalworking and some light wood-working, 900 to 1 000 mm. For model building and other work while sitting, 735 mm (desktop).

Lighting: T8 fluorescent fixtures spaced depending on bulb length, reflector and lens type. Articulating worklight by bench for detailed work.

Paint ceiling white, walls a light colour to scatter light.

Put lighting on one branch circuit. Power-tool outlets go on a separate circuit. If you trip the circuit breaker with a power tool, you don't also knock out the lights.

Bin storage for fasteners, wire connectors, small plumbing parts, miscellaneous hardware.

Shelves for power tools in existing plastic cases or in workshop-made plywood containers.

Flooring: On bare concrete, use clear sealer or two-part epoxy floor coating to improve traction and light

reflection, and to make spills easier to clean.

Rubber mat by workbench improves traction, reduces fatigue, prevents damage to dropped tools. Snap-together modular flooring improves traction, dampens noise, prevents damage to dropped items.

Locate mitre saw with clear access on left and right.

Adjacent work surfaces are flush to mitre saw table.

Magnetic bar above workbench holds tools of all different shapes, sizes.

Hang bench brush near bench to sweep off directly into waste bin. Or use 10-litre wall-mount wet-dry workshop vacuum.

Refrigerator. Beer.

into its leg. Most people might have purchased a sawhorse at that point. Not Hickman. Hickman set out to design and build a small, portable workbench. The idea he came up with, to solve a relatively simple problem with a complex device, is a classic example of what makes an inventor. Most fail in their attempt, but some succeed, and civilisation moves steadily forward.

After a lot of experimenting, Hickman arrived at a working design that was part bench, part vice, and part sawhorse. Black & Decker bought the rights to produce the thing. About five years after it came on the market in North America, I saw one for the first time when the owner of a construction company I was working for pulled one out of his pick-up. It was then and remains a marvel of industrial design. You can set it up in seconds. It stores flat. And it's light. The 425 Workmate, the current version,

weighs in at 12 kilograms and is rated to support 250. It sells for the equivalent of a hand tool. You can use it to hold a bike you're repairing, clamp construction timber to build a shed, and for about a million other things. If success is measured in numbers, the Workmate became a blockbuster. Black & Decker estimates that 30 million of them have been sold worldwide.

I've been an editor at POPULAR MECHANICS for twenty-six years. I've purchased two Workmates for the magazine in that time. We're always driving around doing some project or another, and they are indispensable. But sometimes I have the urge to work without it. Why? Because when you don't have what you need, you're forced to improvise, and only improvisation could lead to an invention like the Black & Decker Workmate. Hey, you never know. – ROY BERENDSOHN

SOME THOUGHTS ON

Dust

Sawdust, plaster dust, drywall dust, any kind of dust – none of it is good for your lungs, your floor, your tools, or your desire not to start a fire. Getting rid of it is both essential and easy.

RULE 1: Catch dust while it's airborne.

► Because dust is first suspended in the air, it makes sense to use air to transport it for disposal. A wet-dry workshop vacuum will take care of most of it. For example, hook a Dust Deputy cyclone collector to work with any vac and you create an efficient two-stage dust collector that mimics what industrial wood shops use. The funnel-shaped Deputy swirls wood chips and dust like water going down the drain, collecting them in the bottom of the tank – the first stage. The remaining fine particles continue to the workshop vacuum and its air filter.

RULE 2: Be inventive.

► Poke around woodworking-supply Web sites and you see all kinds of adaptors, hoses and shrouds to hook up to your equipment. That's how we found the dust-trapping ChopShop Saw Hood from FastCap (fastcap.com). Sawdust flies against the slippery back of the hood and falls by gravity into a spare cardboard box. Mission accomplished.

If you prefer a home-brewed solution, make a hood out of plywood, particleboard, or sheet metal. Timberyards did this all the time at the height of the radial-arm-saw era.

RULE 3: Sweep up the rest.

► Don't waste your time with cheapo brooms and a flimsy dustpan. Buy a contractor-grade push broom, a commercial-duty bench brush, and a big aluminium or steel dustpan.



THE NEW ESSENTIALS

Most of the tools you need are the same stuff your grandfather needed. And yet innovation persists. Your grandfather would have loved a cordless circular saw.

01

Craftsman's **Mach Series wrench** is forged from a block of steel for the ultimate in strength and durability. To adjust its jaws, just slide the thumb button.

02

We've seen the future of handheld cordless tools, and it's brushless. The motor on **Makita's 18-volt XJV02Z cordless jig saw** runs practically forever and optimises speed and torque for cutting metal, wood and composites.

03

The classic 1,8-metre folding ruler gets an update with the Swiss-made **Rhino Ruler**: wear-resistant glass fibre-reinforced polyamide plastic with engraved (not painted) graduations on both sides. Its spring-loaded joints are tough and fold with a precise snap. Nice ruler.

04

Next time your cousin-in-law needs to borrow tools, pack them in the **FatMax 4-in-1 Mobile Work Station**. This combines a deep bin, a small-parts bin with removable dividers, and a toolbox with lift-out tray in a clever hand-truck design, which makes it easy to take home the twelve-pack he owes you.

05

Bosch is known for the power and precision of its **portable planers**, and with the introduction of the PL1632, you are again reminded why. For power it's got a 6,5-amp motor. For precision its cutting tool adjusts in 0,4 mm increments. Which is handy, because you can't add the wood back.

06

Machine-tool precision meets woodworking with the **Woodpeckers Precision Aluminium Square**. It's CNC-milled from a block of aluminium to plus or minus 25 thousandths of a millimetre along its edges. A fence holds the square itself to the surface, requiring only gentle pressure from you to hold it against the edge.

07

The **Kreg Jig K5** is a self-contained pocket-screw fastening. Its ratchet clamp quickly grips and releases any wood, and drill and drive bits and screws are stored in two compartments.

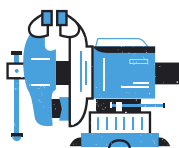
08

Milwaukee throws down the gauntlet with its **M18 185 mm circular saw**. Weighing just 4 kg (with battery), the 18-volt tool is lighter and faster than corded saws, the company says. Our impression after a test drive: yep. It's fast and light. And its magnesium shoe is as slippery as a piece of cookware.

tool. // The pocket screw is the greatest of all screws. // Think. Measure. Mark. Think. Cut. In that order. // Just buy a whole bunch of

KNOW YOUR VICES

You can't do good work without a good vice.



FOR MOST JOBS

The head on the Yost 750-DI rotates 360 degrees, with stops every 30 degrees. When combined with its swivel base and three types of jaws (parallel, V, and pipe), it holds anything.

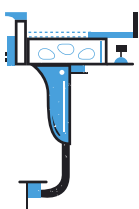
JAW OPENING: 125 mm
Yostvices.com



FOR ODD-SHAPED THINGS

Lash a chain vice around an object and tighten with a couple of cranks. The Ridgid 10P is designed for pipe, but also secures objects such as andirons and taxidermy.

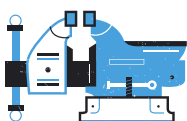
JAW OPENING: Pipe diameter up to 200 mm
Ridgid.com



FOR CONSTRUCTION AND REMODELLING

Screw BenchJaws to a bench or any ridged surface. They clamp with a foot-activated lever, leaving your hands free, and support 100 kg with up to a ton of clamping force.

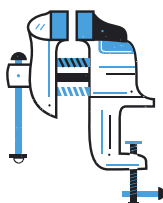
JAW OPENING: 400 mm (with accessory jaw, 600 mm)
Rockwelltools.com



FOR BASHING METAL

Equal parts anvil and vice, the Yost FSV-7 is the last word in strength, impact resistance, and durability. It's not built of ductile iron (strong) or even cast steel (stronger) but forged steel (just ridiculous), right down to its three-hole swivelling base.

JAW OPENING: 175 mm
Yostvices.com



FOR PORTABILITY

You don't always have access to a workbench to hold a vice. Sometimes a sawhorse or even a piece of timber has to stand in. But clamp the Yost Model 250 vice to any surface up to 47 mm thick and you've got yourself a set-up.

JAW OPENING: 57 mm
Yostvices.com



A space perfected

Nobody can define the perfect workshop for anybody else. That space is a fingerprint, as personal as musical taste. Put me in a workshop that looks the way jazz sounds and I'd find the first tool that would allow me to cut out my eyes. There aren't even any universal adjectives that we could apply: "Clean" might seem like an obvious one, but I know good carpenters who thrive in clutter. We could agree that certain tools are a must – a table saw, for instance – but then we'd diverge, because saws are like golf clubs, like steering wheels. They're instruments that fit our hands, and no two feel alike.

The best single workshop I've seen (if only on video) is Nick Offerman's temple to sawdust. He's the actor who played Ron Swanson on *Parks and Recreation*, and he's a woodworker of considerable grace. I'm sure his workshop, in the flesh, is some rare combination of financial and technical wherewithal, the product of a man who has money and knows how to use the precision machines he buys with it. I'm just as sure I could find a different woodworker who would walk into Offerman's workshop and sniff out a hundred faults. That guy would be a jealous loser, but he's out there.

So where does that leave us? Even if we don't agree on what blades are necessary, I can't think of a single craftsman who wouldn't want those blades to be sharp. At least one surface that is clear and level enough to split atoms. Light that is warm and raises the finest grain.

Mostly, though, I think the perfect workshop comes down to something more ephemeral, that same elusive sensation that draws any of us to a particular hammer or paintbrush. The perfect workshop is, in its own way, a tool rather than a collection of them, only it does its work on us. It makes us feel capable, and it makes us feel content, and it makes us feel as though we can make every last thing we might dream to make. – CHRIS JONES

PM

Maker
Fact

02
02

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Popular Mechanics

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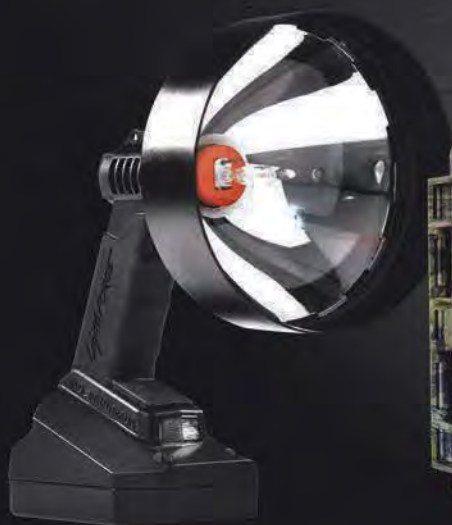
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SLIP-FREE SCREWDRIVING

Everyone who has had to screw in slotted screws with an electric drill knows the feeling when the flat head slips and your bit gets rammed into the wood, leaving a nasty dent. My solution to this problem is to cut a small plastic tube that fits around the bit. The length must be almost as long as the bit, to allow for countersinking. Slip this over your screw and you can drive it all the way down without it slipping and damaging the wood. If you don't have the right diameter piping, you can make a temporary sleeve by wrapping a long strip of paper around the bit and taping it with some masking tape. The pictures show my invention being successfully used by my dad when fixing our wooden deck.

MICHAEL WOERMANN
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RYAN HILL
NORTHGATE

SPOTTED

Time and again I find myself in a position where I have to mark and drill holes in one component that I would like to fasten to another, which already has mounting holes with a specific pitch.

Without exposing myself to some tedious measuring and marking exercise, I'll explain my solution to this problem by means of an example.

Let's say you want to replace a light fitting in your house with a new one, but you would like to utilise the existing mounting holes in the ceiling, which will most likely consist

of two or more holes with some odd pitch.

You can mark the position of these holes on your new light fitting by applying a droplet of grease over each hole in the ceiling. By simply pressing the mating surface of the new light fitting up against the ceiling, the spots of grease will be transferred to the fitting, thus marking the spots where you should drill your holes in the new fitting.

In some cases the mating surface might have some standoff that will prevent the grease spot transfers. This can be accommodated by inserting the designated screws in their respective holes in the ceiling and by squirting a bit of Tippex on the head of each screw. You will transfer the white droplets to your new fitting using the standoff provided by the screws.

JACQUES VAN DYK
PRETORIA

ENERGISE LAZY REMOTES

Bugged by remote controls with a "lazy" button? My hint is specifically for a PVR remote control, but would probably work just as well on others.

Remove batteries and central holding screw. Open the remote by prising apart the two halves with a suitable tool (I used a 20 mm wood chisel), starting from the bottom. Cut 5 mm diameter discs out of household foil (I used a ring binder paper punch). To one side of the disc, apply a minute amount of Prestik, about the size

of a pinhead, press this firmly on to the back of the lazy button and reassemble.

MIKE GREEN
DAINFERN



CUT-PRICE CUTTER

For those like me who have endured many years of continuous frustration with a variety of makes and models of edge trimmers and their gut spooling system, here's my quick fix.

I removed the spooling system, leaving only the drive hub at the base of the device. Using cable ties, one per side, inserting through the original eyelets in the hub, I have a very reliable, strong, long-lasting and easy replaceable cutting gut. The loop through block at the end of the cable tie acts as a sturdy lock system, as it does not fit through the eyelet.

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